Household Demand Analysis for Assessing Nutritional Impact of Development Programs

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ABSTRACT

A procedure was developed for estimating a full matrix of demand elasticities for a developing economy using household survey data. The results, as applied to Sri Lanka, show that the estimates appear to be reasonable in magnitude and internally consistent. The demand elasticities can serve as a useful tool in policy decisions. They are used to investigate expected changes in per capita quantities of nutrients consumed as a result of alternative development programs.

KEYWORDS: Consumer demand, elasticity estimation, nutrient consumption, household survey, developmental programs.

CONTENTS

PREFACE

Food in adequate quantities and quality is the most basic of man's needs. In many developing countries both the quantity and quality are barely adequate. Moreover, in some of these countries, certain segments of the population obviously have inadequate diets. Yet the market demand for food in developing countries is little understood. The few studies available have focused on one or a few large aggregate commodity groups. Comprehensive studies of food demand that consider specific commodities are rare and largely confined to highly developed economies.

The problem of poor diets in developing countries has been and continues to be widespread and persists despite substantial agricultural development efforts on the part of many, including the U.S. Government. The reasons are several and varied, but an important contributing factor has been the lack of information on the food demand and consumption behavior of specific consumer groups. Information that does exist is usually derived from national aggregate data and thus limited to national coverage and consideration of one or a few large aggregates of commodities. The result is that analysis of the potential impact of food policy decisions on the consumption of specific commodities by specific income groups cannot be done.

An additional problem has been the lack of appropriate data. Food demand analysis has traditionally relied on time series data. However, the amount of detailed data needed to estimate the structure of food demand is much greater than what is normally available in most developing countries. Recently many countries have undertaken large scale national household food consumption and expenditure surveys. These surveys contain the detailed information needed to permit highly disaggregated analysis of food demand.

With this background in mind, the current work in food demand and consumption in developing countries was initiated in the Agricultural development Branch, International Economic Division of the Economic Research Service. The goal of this work is to increase the knowledge available on the structure of food demand in developing countries. More specifically, the goal is to generate additional knowledge for use in programming U.S. food aid and development assistance, and to improve the accuracy of global food demand projections.

The specific objective of this research at this time is to develop a procedure to analyze food demand as a comprehensive system. This requires that the analysis be sufficiently dissagregate so that meaningful policy relevant information is generated regarding the consumption of specific foods by specific segments of the population. Only with detailed information at this level is it possible to make adequate a priori analysis of the potential impact of food policy changes, or to plan agricultural projects to fill these specific food needs.

This staff paper reports on the initial efforts and results of the food demand and consumption work with household survey data from Sri Lanka. The procedure used and specific results are still tentative and subject to revision as refinements are introduced. However, it appears the general approach is valid and generates information critical to food and agriculture policy decisions and to development planning.

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I. INTRODUCTION

1.1 The Rationale

In developed economies there is growing recognition that agricultural policy must be based on a comprehensive analysis of the sector. The myriad of supply-demand interrelationships, both within and outside the sector, makes such analyses difficult but increasingly important for effective policy planning and implementation. The results of policies based on partial analysis can be counter productive because the desired effect is offset by unintended consequences. The attendant social and economic costs can be very high in these instances.

In developing economies, the need for comprehensive analysis as a basis for agricultural policy is equally as important. This importance derives from little understood supply-demand relationships for food, and from the potential human costs associated with uninformed policy decisions. This latter cost, which is in addition to the social and economic costs experienced by developed economies, can be extreme in that mass hunger and malnutrition can result. The potential loss of human capital is in itself a powerful argument for comprehensive analysis as a backstop to agricultural and developmental policy decisions.

Consumer demand for food is an important component of the agricultural sector structure. It is, however, a complex and interrelated network of relationships, even in the simplest of economies. Unfortunately, with a few notable exception, consumer demand studies have been partial analyses, failing to account for this interdependent nature of food demand. This failure has been due to a lack of both appropriate methodology and data.

Fortunately, the theoretical issues related to the methodological problems have been largely solved. The major stumbling block is the lack of data, especially time series data in developing countries. However, during the last decade, an alternative data source has emerged in several LDC's in the form of household surveys on food consumption and expenditure.

Compared to the macro-level time series data, this micro-level data has both strengths and weaknesses for policy analysis. A major weakness is the lack of time perspective. Survey data can only provide short-run estimates of demand parameters, which are sensitive to possible sampling bias and seasonal fluctuations embedded in the data. The strength of this data source lies in the sample size and the wealth of detailed information, which allows the estimation of more parameters, and, in some cases, estimates for specific consumer groups.

Given the fundamental role knowledge of food demand parameters can have for agricultural policy decisions in developing economies, it is critical that efforts be made to provide these estimates for as many countries as possible. Presented in a systematic, program-oriented framework, these parameters can make a major contribution to effective agricultural policy planning, by both donor and recipient countries.

During the past several months, a research group within the International Economics Division/USDA has developed a procedure which can use household survey data to estimate the demand structure for approximately 20 food groups. The procedure capitalizes on the wealth of detailed food purchase information and the large number of households found in typical national consumption study, to provide statistical estimates for the own- and cross-price elasticities, as well as the income (expenditure) elasticities. This work takes its inspiration from recent similar work in Columbia and Canada. In previous work of this nature

it was assumed time series data was necessary.

A further advantage of using household survey data is the possibility of subsampling within the larger sample. In the present study using Sri Lankan data, it has been possible to make separate estimates for 10 income groups, 5 each in rural and urban areas. These subsamples, together with the detailed food purchase information available on each household, allows a level of data disaggregation and analysis not possible with time series data.

Once the demand elasticity estimates have been obtained, they are used to calculate nutrient intake levels. In this manner, the nutritional impact of any development program influencing prices and quantities, or household income levels, can be estimated a priori. Alternatively, the procedure can be reversed. That is, nutritional goals which meet the needs of specific segments of the LDC's population can be established and used as criteria for planning development programs. Further, insight can be gained into the relative impact of the policy variables, and hence, of program options.

Analysis of data from Sri Lanka shows that demand for food varies among commodities and income groups, and also differs by rural versus urban residence. Investigation of a hypothetical policy change increasing the price of staple foods, indicates that higher income groups are made no worse off, while low income groups lose substantially in daily per capita calories consumption. Similarly, for production increases in staple foods, increased consumption does not occur uniformly across either the staple foods or the income groups. Hence, the procedure developed provides the detailed information needed to plan agricultural programs and policies which will impact favorably on those groups with nutritional needs.

1.2 The Objectives

The overall purpose of this study is to discuss the methodology and results of an effort to estimate, from household survey data, a full matrix of demand elasticities for a developing economy. Specifically, the objectives are:

(a) To briefly review consumer demand theory, the necessary assumptions, major limitations, and implications for studies of food demand structure and policy analysis.

(b) To review the methodology of previous studies which have constructed complete demand elasticity matrices.

(c) To present the procedure used in this study to construct a complete demand elasticity matrix from household survey data for a developing economy.

(d) To present empirical results and to discuss the relevance and policy implications of the results for developing countries.

Readers not interested in the technical aspects of the estimation procedure may wish to go directly to the discussion of the results and policy implications.

2.0 A Brief Review of Consumer Demand Theory

2.1 Classical Demand Theory: Basic Equations

This abbreviated review is included to illustrate the derivation of demand functions. It serves as a prelude to the discussion of application of theory in empirical analysis presented later. Complete treatments of the theory are well documented and references are readily accessible. These include Hicks (1939), Samuelson (1947), Henderson and Quandt (1958), Barten (1964), Stigler (1965), and Theil (1967).

Classical theory of consumer demand is based upon the theory of utility maximization. Quantities purchased by a consumer are assumed to be optimal quantities, reflecting his or her attempts to maximize utility, given that individual's constraints. Thus

$$u = f(q_1, q_2, \ldots, q_n) \tag{2.1}$$

under the budget restraint of

$$\sum_i p_i q_i = y, \tag{2.2}$$

where q_i represents the quantity of the ith commodity, p_i represents the price of the ith commodity, and y designates total expanditure of income.

Maximization of the utility function (2.1) subject to the budget constraint (2.2) is carried out by the Lagrangian method. To find the first order conditions for a local maximum, one forms the expression

$$L = U - \lambda \left(\sum_i p_i q_1 - y\right)$$

where λ is a Lagrangian multiplier, interpreted as the marginal utility of income.

Differentiating L with respect to q_i and λ , one obtains:

$$\frac{\partial L}{\partial q_i} = \frac{\partial U}{\partial q_i} - \lambda p_i \tag{2.3}$$

$$-\frac{\partial L}{\partial \lambda} = \sum_i p_i q_i - y \tag{2.4}$$

Setting the above derivatives equal to zero yields

$$\frac{\partial U}{\partial q_i} = \lambda p_i \qquad (i = 1, \ldots, n) \tag{2.5}$$

$$\sum_i p_i q_i = y \tag{2.6}$$

The second order conditions for a constrained maximum involve the bordered principal minors of the Hessian matrix. Given a bordered Hessian matrix

$$\begin{bmatrix} 0 & p_1 \cdots p_n \\ p_1 & U_{11} \cdots U_{1n} \\ \cdot & \cdot \cdots \cdot \\ p_n & U_{n1} \cdots U_{nn} \end{bmatrix}$$

where

$$U_{ii} = \frac{\partial^2 U}{\partial q_i^2} \quad \text{and} \quad U_{ij} = \frac{\partial^2 U}{\partial q_i \partial q_j}$$

The bordered principal minors are defined as:

$$\begin{vmatrix} 0 & p_1 & p_2 \\ p_1 & U_{11} & U_{12} \\ p_2 & U_{21} & U_{22} \end{vmatrix}, \ldots, \begin{vmatrix} 0 & p_1 \cdots p_n \\ p_1 & U_{11} \cdots U_{1n} \\ \cdot & \cdot \cdots \cdot \\ p_n & U_{n1} \cdots U_{nn} \end{vmatrix}$$

The above determinants should be alternately of positive and negative sign to fulfill the second order conditions.

The system of equations found in the first order conditions (2.5) and (2.6) provide the solution of n optimal values of q_i and the equilibrium value

of λ according to the implicit function theorem.[1/] For variable prices and income, this solution appears as a system of n demand functions, which describe the behavior of the consumer in the market. The resulting demand functions are:

$$q_i = q_i\ (p_1,\ \ldots,\ p_n,\ y) \qquad (i = 1,\ldots.,n) \qquad (2.7)$$

and

$$\lambda = \lambda\ (p_i,\ \ldots,\ p_n,\ y) \qquad (2.8)$$

2.12 Derived Properties

Several properties or conditions of the demand functions can be derived from the utility maximization assumption. A full discussion of these conditions is given the Wold and Jureen (1953). These properties take the form of mathematical restrictions on the derivatives of the demand functions. With reference to (2.7), the restrictions are:

a. <u>Homogeneity Condition</u>

The first order conditions (2.3) and (2.4), imply that if all prices and incomes are changed by the same proportion, the quantity demanded must remain unchanged. In other words, each demand equation must be homogeneous of degree zero in prices and income. To show this, take the total differential of the demand equation

$$q_i = qi(p_j,\ \ldots,\ p_n,\ y),\ \text{and}$$

using Euler's theorem from homogeneous functions of degree zero, we have

$$p_1 \frac{\partial q_i}{\partial p_1} + p_2 \frac{\partial q_i}{\partial p_2} + \ldots + p_n \frac{\partial q_i}{\partial p_n} + y \frac{\partial q_i}{\partial y} = 0 \qquad (2.9)$$

[1/] According to this theorem, there should be a solution $(q_i,\ \lambda)$, and the utility function must be quasi-concave (which implies non-singularity in the bordered Hessian).

or, in general

$$\sum_j p_j \frac{\partial q_i}{\partial p_j} + y \frac{\partial q_i}{\partial y} = 0 \quad (i, j = 1, 2, \ldots, n) \qquad (2.10)$$

If all elements in (2.10) are divided by q_i, we obtain price and income elasticities,

$$\sum_j \frac{p_j}{q_i} \frac{\partial q_i}{\partial p_j} + \frac{y}{q_i} \frac{\partial q_i}{\partial y} = 0$$

This implies that the direct and cross elasticities with respect to prices of any commodity i and its income elasticity add to zero. That is,

$$\sum_j e_{ij} + e_{iy} = 0$$

b. <u>Slutsky Condition or Symmetry Relation</u>

Slutsky (1915) pointed out that the effects of a price change on quantity demanded can be decomposed into an income and substitution effect. To show this, consider the demand function $q_i = q_i\ (p_1, \ldots, p_n, y)$, and suppose that price p_j has increased, other prices and income remaining constant. With the increase of price p_j, the purchasing power of the consumer is reduced. But suppose the consumer is compensated for the loss, $dy = q_i dp_i$. Hence,

$$q_i = \frac{dy}{dp_j}$$

Thus, with compensation, there are two variations, one in price p_j and one in income y, which influence the quantity purchased.

$$q_i = \frac{\partial q_i}{\partial p_j} dp_j + \frac{\partial q_i}{\partial y} dy, \text{ and}$$

$$\frac{dq_i}{dp_j} = \frac{\partial q_i}{\partial p_j} + \frac{\partial q_i}{\partial y} \cdot \frac{dy}{dp_j} \qquad (2.11)$$

Since $\frac{dq_i}{dp_j}$ is the response of q_i to a compensated price change for a constant utility, it can be expressed as $\left(\frac{dq_i}{dp_j}\right)_{u\,=\,\text{constant}} = K_{ij}$, called the substitution effect.

The equation (2.11) may be rewritten as:

$$\frac{\partial q_i}{\partial p_j} = K_{ij} - q_j \frac{\partial q_i}{\partial y} \qquad (2.12)$$

The last term on the right hand side of (2.12) is the income effect.

It can also be shown that the substitution effects are symmetrical, i.e.

$$K_{ij} = K_{ji} \text{ or that } \frac{\partial q_i}{\partial p_j} + q_j \frac{\partial q_i}{\partial y} = \frac{\partial q_j}{\partial p_i} + q_i \frac{\partial q_j}{\partial y}$$

In terms of elasticities, we obtain

$$e_{ij} + w_j\ e_{iy} = \frac{w_j}{w_i}\ e_{ji} + w_j\ e_{jy}, \text{ or}$$

$$e_{ij} = \frac{w_j}{w_i}\ e_{ji} + w_j\ (e_{jy} - e_{iy}) \qquad (2.13)$$

where $w_i = \frac{p_i q_i}{y}$ represents the share of expenditures on the commodity.
For a change in its own price, the substitution effect in a commodity becomes

$$K_{ii} = \frac{\partial q_i}{\partial p_i} + q_i \frac{\partial q_i}{\partial y} \qquad (2.14)$$

which is a negative value.

The elasticity values commonly estimated are uncompensated. The relationship between the compensated and uncompensated values is useful information and has been shown (Mann, 1980) to be

$$\eta_{ij} = e_{ij} + w_j\ e_{iy},$$

where η_{ij} is the compensated elasticity. Other terms are as previously defined.

c. Engel Aggregation

The budget restraint denoted in (2.2) is:

$$\sum_i p_i q_i = y, \; (i = 1, 2, \ldots, n)$$

Partially differentiating the above equation with respect to y gives:

$$\sum_i p_i \frac{\partial q_i}{\partial y} = 1, \text{ or } \sum_i \frac{p_i q_i}{y} \frac{y}{q_i} \frac{\partial q_i}{\partial y} = 1, \text{ or}$$

$$\sum_i w_i \, e_{iy} = 1 \qquad (i = 1, 2, \ldots, n) \qquad (2.16)$$

This Engel aggregation states that the sum of income elasticities weighted by the respective expenditure shares is equal to one.

d. Cournot Aggregation

By differentiating the budget restraint (2.2) with respect to the price of the jth commodity, we have:

$$\sum_i p_i \frac{\partial q_i}{\partial p_j} + q_j = 0, \text{ or}$$

$$\sum_i p_i \frac{\partial q_i}{\partial p_i} = -q_j$$

This can be expressed as:

$$\sum_i \frac{p_i q_i}{y} \cdot \frac{p_j}{q_i} \cdot \frac{\partial q_i}{\partial p_j} = - \frac{p_j q_j}{y}$$

Expressed as elasticities, this becomes:

$$\sum_i w_i \, e_{ij} = -w_j, \; (i = 1, 2, \ldots, n). \qquad (2.17)$$

The Cournot aggregation condition implies that the weighted sum of the elasticities for commodity "j" is equal to the negative of the expenditure share of the jth commodity.

2.2 Estimating the elasticities

In applied consumption analysis, the objective is to estimate the elasticity values. However, a problem emerges because the number of food commodities of interest is typically very large. With no restrictions, the total number of own-, cross-, and income elasticitiy estimates is $n^2 + n$. Hence with only 20 food commodities (or commodity groups) the total number of parameter estimates is 420. This formidable task is made more difficult by the degrees of freedom problem associated with estimation equations. Usually, and especially

with time series data, the total number of observations is not sufficient to permit direct estimation of all parameters.

To circumvent this problem, many consumption studies have been confined to a few aggregate commodities. However, even in this approach, there can be a problem with insufficient degrees of freedom using time series data. In this case it is necessary to make a priori assumptions regarding the value , usually zero, for some cross elasticities. While this procedure does allow the statistical estimation procedure to proceed, it is not a comprehensive approach to the analysis. The only defense of this procedure is that more elasticity values can be estimated than would be possible without the a priori assumptions.

But if a priori assumptions can be made for individual elasticity values, it may be reasonable to make such judgments for categories of elasticity values. This is broadly termed the "integrationist" approach. This approach recognizes the demand interrelationships among commodities, but reduces the number of independent estimates needed by making various assumptions regarding the nature of the consumer's utility function.

It is useful to begin by considering the reduction in independent estimates achieved through use of the derived properties. Starting with a total of $n^2 + n$ derived estimates, imposition of the symmetry relationship reduces this number by $\frac{1}{2}(n^2 - n)$. The Cournot and Engle aggregation restriction make a further reduction of $n + 1$ estimates. This leaves $\frac{1}{2}(n^2 + n) - 1$ independent elasticity values to be statistically estimated.

If the example of 20 food commodities (or commodity groups) is again used, this means 209 independent estimates are needed. Using the rule of thumb that the number of observations should be 2 - 3 times the parameters to be estimated, this means roughly 400 - 600 observations. Even with quarterly observations, this is an impossibly long time series, and additional restrictions are

needed if time series data are to be used. These restrictions would also prove useful in the analysis of cross sectional data where the sample (or cell) size is too small for direct parameter estimation.

2.21 Separability

The concept of separability refers to a simplifying assumption regarding the consumer's consumption patterns. Specifically, it is assumed commodities available to and purchased by the consumer can be partitioned into mutually exclusive and exhaustive subsets on the basis of underlying common characteristics. Behaviorally, this implies the consumer first allocates income between subsets, then secondly allocates expenditure within subsets. The extent to which demand interrelationships are assumed to exist between subsets results in "strong", "weak", or "Pearce" separability.

While even a brief discussion of separability is beyond the scope of this work, it is important to summarize the implications. First, strong separability implies an additive utility function. Weak separability carries no such implication, while Pearce separability has aspects of both. Specifically,

a) for strong separability

$$\frac{\partial \left(\frac{u_i}{u_j}\right)}{\partial q_k} = 0 \qquad \text{for all } i \text{ in } I,\ j \text{ in } J \text{ and}$$

k not contained in I or J.

b) for weak separability

$$\frac{\partial \left(\frac{u_i}{u_j}\right)}{\partial q_k} = 0 \qquad \text{for all } i \text{ and } j \text{ in } I, \text{ and}$$

k not contained in I.

c) for Pearce separability

$$\frac{\partial \left(\frac{u_i}{u_j}\right)}{\partial q_k} = 0 \qquad \text{for all i and j in I, and}$$

$k \neq i, j.$

An important result is obtained in the strong separability case if it is extended to the individual commodity (or commodity group) level. This gives a point-wise, strongly separable situation such that $u_{ij} = 0$ for all $i \neq j$. In this case goods are called "want-dependent." Use of this procedure, first proposed by Frisch (1959), enables the estimation of all direct and cross elasticities from knowledge of income elasticities, money flexibility, and budget shares.

The want-independent procedure is, however, highly restrictive and is only properly used when large aggregate commodity groups are under study. Since this is not the case with food demand analysis, the procedure must be used sparingly and with caution. But since there are situations where no alternatives exist, the Frisch prodecure is reviewed below.

In general the restrictions from strong, weak, and Pearce separability, when incorporated into demand equation systems, result in either 2n or n + 1 independent parameters to be estimated. The more widely known of these, linear expenditure, indirect addilog, and Rotterdam, are particularily well suited to time series data if the associated assumption are reasonable for the analysis in question. However, these procedures will not be discussed in detail here.

2.22 Want Independence

Frisch pointed out that, under the assumption of want independence, all direct price and cross price elasticities can be estimated. He expressed price elasticities (e_{ij}) in terms of want elasticity (σ_{ij}), budget shares

(w_j), income elasticities (e_{iy}), and the flexibility of money (ϕ):

$$e_{ij} = \sigma_{ij} - w_j e_{iy} - \frac{1}{\phi} w_j e_{jy} e_{iy} \qquad (2.18)$$

$$\text{where } \sigma_{ij} = \frac{\partial q_i \; (U_1, U_2, \ldots, U_n)}{\partial U_j} \cdot \frac{U_j}{q_i}$$

and $\phi = \frac{\partial \lambda}{\partial y} \cdot \frac{y}{\lambda}$, and $\lambda = \frac{\partial U(q_1, q_2, \ldots, q_n)}{\partial y}$, i.e. the marginal utility of money. For income elasticities, Frisch had $e_{iy} = \phi \Sigma \sigma_{ij}$ (2.19)

In the case where a good is want independent of all other goods, i.e. $\sigma_{ij} = 0$ for all $i \neq j$, then,

$e_{ij} = -w_j e_{iy} - \frac{1}{\phi} w_j e_{jy} \, e_{iy}$, or

$$e_{ij} = -e_{iy} w_j \left(1 + \frac{e_{jy}}{\phi}\right) \text{ (Cross elasticity), and} \qquad (2.20)$$

$$e_{iy} = \phi \sigma_{ii} \quad \text{(income elasticity)} \qquad (2.21)$$

From (2.21) it is possible to derive

$$\sigma_{ii} = \frac{e_{iy}}{\phi}.$$

Thus, the direct price elasticity can be obtained from (2.18) as

$e_{ii} = \frac{e_{iy}}{\phi} - w_i e_{iy} - \frac{1}{\phi} w_i e_{iy} e_{iy}$, or

$e_{ii} = -e_{iy} \left(- \frac{1}{\phi} + w_i + \frac{1}{\phi} w_i e_{iy}\right)$, or

$$e_{ii} = -e_{iy} \left(w_i - \frac{1 - w_i e_{iy}}{\phi}\right) \text{ (direct price elasticity)} \qquad (2.22)$$

2.3 Estimation of Elasticities from Cross Sectional Data

Developing countries typically do not have extensive or complete time series on food quantities or prices. It is desirable, therefore, to have a procedure suitable for use with cross sectional data taken from household surveys. Such a procedure would allow use of existing data to estimate food demand parameters, and thereby contribute policy relevant information to development planning efforts.

The major problem with cross sectional data is the lack of variability in prices. If the data are gathered within a shourt time span, there may be no price variability except that due to transportation and random variance in the markup value.

Fortunately, few surveys are carried out in such a short time span. Most household consumption and expenditure surveys of national scope take upwards of a year to complete the data collection phase. In most instances, this is sufficient time for price variability to occur. There are, of course, problems with commodities having controlled prices. Frequently, these are the major food commodities; the very commodities for which demand elasticities are most urgently needed.

Even with price variability over the data collection phase, the interpretation of the elasticity values changes slightly from that obtained from time series estimates. Time series estimates made from aggregate data refers to the average behavior of a representative consumer over time. Estimates from cross sectional data provide estimates from which predictions about the future behavior of an average consumer are made. In this respect, the best estimates would be those based on data collected over time from the same households. However, these panel studies are prohibitively expensive when extended to large sample sizes.

Since the validity of the estmation procedure used hinges on the amount and nature of the price variability, this issue is discussed in more detail. If sufficient variability does not exist, or if the observed variability reflects mainly marketing costs and random error, then the meaning of parameter estimates is questionable. Sri Lanka household data is used as the example.

The variablility of prices was checked by calculating the coefficient of variation. The least variable household food commodity price was eggs at 14.57% in Urban Income Group 2 and 3. Most coefficients fell in the ·20 to 30 percent range. A further check on price variability was made by calculating the coefficient of variation of certian household price ratios. Of those checked, the variation of the ratios exceeded that of the individual prices.

As a final check on the price variability, the zero order correlation matrix was computed for Income Groups 2 and 3, both Rural and Urban. Because of the large sample size, a fair number of the correlation values were statistically significant. However, of the 1156 correlation coefficients computed in only three instances was the value high enough to account for more than 10% of the variability. This was the price of rice and other grains, tobacco products and other grains, and eggs and food eaten away from home in Urban areas. In only 11 instances was more tan 5½% of the variance accounted for. Nearly all the correlation values were small that only 1% of the variance between prices was accounted for. Hence, the observed variability appears to be sufficient to provide reliable estimates.

However, there is still the unanswered question of the nature of the price variability. Is it "real" variation, or simply due to marketing costs and random error? Since the Sri Lanka data does not permit this question to be directly addressed, it becomes necessary to examine other evidence for

insight into the nature of the price variation.

We note first that if the observed price variability is due consistently and primarily to marketing costs, there must exist a highly competitive market through the entire economy. This implies the existence of many small retail outlets actively competiting for the business of well informed customers. There are undoubtedly instances where a close approximation to this occures in developing economies, but it is unlikely to hold over wide geographic areas, over time, or over diverse commodities. The reason for the relative lack of competition is the absence of the necessary social infrastrucutre; all weather roads, good storage and transportation facilities, and a well organized market information system for both buyers and sellers. Since this infrastructure is typically lacking in developing economies, it seems reasonable that at least a part of the observed price variability can be attributed to "real" differences in the prices charged to customers. Also, it is unlikely that price ratios, even in adjacent markets, would remain constant.

There are two other sources of price variation that could be significant. One is differences in cost per unit associated with volume purchases. The extent of any volume discount and whether this reflects only differences in packaging and handling costs would depend upon the competitiveness of the market situation.

The second source of variation is time and space. Even though the data derive from a cross-sectional survey, the time span of this national survey was one year. As noted earlier, Hassan and Johnson found their study to be "sufficiently long and for cities sufficiently diverse that a reasonable amount of variation in implicit prices was available for study." (Hassan and Johnson, 55). Thus, given that (a) sufficient variation exists in food commodity prices, (b) indirect evidence suggesting the observed variability may

be "real," (c) the existence of another study which has found elasticity estimates from cross-sectional data to be useful, (d) insufficient time series data, and (e) the great need for the analytical results for policy decisions, it was decided to proceed with the direct estimateion of a full demand elasticity matrix based upon the Sri Lanka household consumption and expenditure survey data.

In summary, the system of demand equations used in the Sri Lanka study is shown below and in Figure 1. The details of the estimation procedure are discussed in a later section of this paper.

The commodity data problems associated with survey data are, in many respects, the opposite of those found in aggregate time series data. That is, the food items are so finely specified that the number of commodities becomes overwhelming. The obvious solution is to aggregate individual food items into commodity groups. But what foods are to be aggregated into which groups? And how many commodity groups are needed?

These are empirical questions that are difficult to answer a priori. The more detailed the data and the demand estimates, the more useful the results for policy planning efforts. The trade-off comes in the degree-of-freedom estimation problem discussed above, and in the number of households recording "no purchase" for the lesser commodities. Such a system below,

$$Q_1 = A_1 + b_{11}\, p_1 + b_{12}\, p_2 + b_{13}\, p_3 + \dots + b_{117}\, p_{17} + b_{1y}y$$

$$Q_2 = A_2 + b_{21}\, p_1 + b_{22}\, p_2 + b_{23}\, p_2 + \dots + b_{217}\, p_{17} + b_{2y}y$$

$$Q_3 =$$

$$\vdots$$

$$Q_{17} = A_{17} + b_{171}p_1 + b_{172}p_2 + b_{173}p_3 + \dots + b_{1711}p_{17} + b_{17y}y$$

Figure I

	. 1 2 3 . . . 17	18	All Food	Non-Food	Income (Expenditure)
1		0			
2					
3	e_{ij}				e_{iy}
.					
.					
.					
17					
Unknown foods= 18	0	0			
All food = 19					
Nonfood = 20					
Buget Share (w_i)					

is a direct specification of the demand equations and requires the estimation of $\frac{1}{2}(n^2 + n) - 1$ apramenters. This, of course, requires a substantial sample size given moderate detail of food items, but not too large for many household surveys. There is also the advantage that no a priori assumptions, such as weak versus strong separability, need be made. This could prove important, since intimate knowledge of consumption patterns may be lacking.

The theoretical conditions employed in construction of the elasticity (now constraint) matrix are listed below:

Homogeneity condition: $\sum_j e_{ij} + e_{iy} = 0$

Slutsky or symmetry condition:

$$e_{ij} = \frac{w_j}{w_i} e_{ji} + w_j (e_{jy} - e_{iy})$$

Engel aggregation: $\sum_i w_i e_{iy} = 1$ (column constraint)

Cournot aggregation: $\sum_i w_i e_{ij} = -w_j$

3.0 Review of Previous Studies

A great number of empirical studies in the United States and some studies in developing countries have been undertaken to explain demand characteristics and consumer behavior. However, these studies are mostly partial analyses made on individual commodities without consideration for the interdependent nature of the demand system. Notable exceptions are found in Brandow (1961), and George and King (1971) for U.S. food commodities, and Hassan and Johnson (1976) in Canada. For developing countries, Per Pinstrup-Andersen et al. (1976) provided empirical application of food demand system model for Columbia, and Le-Si and Pomareda (1976) for Zambia. The purpose of this section is to

outline the general procedure used by Brandow, and George and King for constructing the full demand elasticity matrix at retail level for major food items in the United States.

3.1 Brandow Study

Brandow contructed a complete demand elasticity matrix (2) for 24 foods or food groups, of direct, cross price, and income elasticities. The model is synthesized in that several statistical estimates were taken from other studies. The analysis used the theoretical restrictions on the coefficients to provide internal consistency to the demand matrix.

In the estimation process for the 24 commodity items or groups, Brandow first constructed a table of elasticities for 14 foods (groups). He combined all meats, poultry, and fish (7 items) into a single group called "meat," and butter, margarine, etc. . . . into a "fats and oil" group. The expansion of the table from 14 items to 24 items was based on the assumption that the influence of the price of food, other than "meat" or "fats and oil" would affect demand for each individual meat or each individual "fat and oil" item identically.

The estimation of elasticities for the 14 foods (groups) may be outlined as follows:

1. Estimation of direct price elasticities which form the main diagonal of the elasticity matrix (e_{ii}).
2. Estimation of income elasticities for each food (e_{iy})
3. Estimation of cross-elasticities showing the influence of non-food prices on the demand for individual foods (e_{inf}).
4. Estimation of cross-elasticities showing the effects of food prices on non-food demand by application of the symmetry condition (e_{nfi}).

5. Estimation of cross-elasticities for individual foods (e_{ij}).

The last step of the procedure may be broken down as follows:

a. For the first row, the sum of food cross-elasticities $R_1 = \sum_2 e_{1j}$ could be deduced since the direct price elasticity (e_{11}), the non-food cross elasticity (e_{inf}), and the income elasticity (e_{11}) were known from previous steps of the procedure. Hence, under the homogeneity condition,

$$e_{11} + \sum_2 e_{1j} + e_{1nf} + e_{1y} = 0, \text{ or}$$

$$R_1 = \sum_2 e_{1j} = -(e_{11} + e_{inf} + e_{1y})$$

b. For the first column, each value of the food cross-elacticities e_{ij} was chosen so that it was proportional to R_1 and the weighted sum of all cross elasticities met the Cournot aggregation condition,

$$w_1 e_{11} + \sum_2 w_i e_{i1} + w_{nf} e_{nf1} = -w_1, \text{ or}$$

$$\sum_2 w_i e_{i1} = -(w_1 + w_1 e_{11} + w_{nf} e_{nf1})$$

c. Once the food cross-elasticities in the first column were known, the food cross-elasticities in the first row could be deduced using the symmetry condition.

d. For the second column, the individual food cross-elasticities were chosen so that their values were in proportion to $R_2 = \sum_3 e_{2j} = -(e_{22} + e_{2nf} + e_{2y})$ and their weighted sum was $\sum_3 w_i e_{i2} = -(w_2 + w_1 e_{12} + w_2 e_{22} + w_{nf} e_{nf2})$ The individual food cross-elasticities in the second row e_{2j} were computed by the symmetry relation.

e. These steps were repeated for the remaining columns and rows to complete the table.

The estimation of demand elasticities for total food was made using several time-series analysis, judgment based on elasticity values from other studies, and Frisch's relations, so that the price and income elasticities summed to zero. The cross-elasticities showing the effects of the price of total food

on individual foods were the sums of direct and cross-elasticities across the row for each food. The cross-elasticities showing the effects of the prices of individual food items on total food were computed by symmetry.

Since many of Brandow's direct price elasticities were derived from other studies, there is not complete consistency in the estimation methods and time periods used. Also it was necessary to use personnal judgment to assign some elasticity values to meet the theoretical restrictions.

3.2 George and King Study

George and King constructed a complete matrix of demand interrelationships for 49 foods or food groups. The food commodities were chosen on the basis of their share of the food budget (at least .3 percent) and the availability of data on prices, quantities, and incomes. The theoretical restrictions were used in the specifications of demand coefficients.

The elasticity matrix was constructed as follows:

1. Constructing the 15 commodity groups: The 49 food commodities were combined into 15 groups using the method developed by deJanvry (4). The grouping is based on proportionality factors as functions of price elasticities, income elasticities, and budget shares.

2. Estimation of coefficients of each commodity within each group: Within each group, a demand equation for each commodity was specified with the quantity as the dependent variable and as independent variables the price of all individual commodities in the same group, price indices of other food groups, and income. In this manner, the direct price elasticity (e_{ii}), the cross price elasticity (e_{ij}), and the income elasticity (e_{iy}) for each food item was directly estimated. Several estimates were made for each coefficient using both annual and quarterly data, and by using both logarithmic form and the first difference of variables logarithms. One estimate was chosen for

each coefficient after checking certain desirable statistical properties, use of intuitive judgment, and reference to the theoretical properties of the parameters.

3. Estimation of income elasticity for all food (e_{fy}): This was calculated as the weighted average of the income elasticities for individual commodities.

$$e_{fy} = \frac{w_1 e_{1y} + w_2 e_{2y} + \ldots + w_{49} e_{49y}}{w_1 + w_2 + \ldots + w_{49}}$$

where the w_i are expenditure proportions.

4. Estimation of income elasticity of nonfood (e_{50y}):

Using the Engel aggregation condition we have,

$$w_1 e_{1y} + w_2 e_{2y} + \ldots + w_{49} e_{49y} + w_{50} e_{50y} = 1$$

Thus,

$$e_{50y} = \frac{1 - (w_1 e_{1y} + w_2 e_{2y} + \ldots + w_{49} e_{49y})}{w_{50}}$$

5. Estimation of direct price elasticity for all food (e_{ff}):

The Frisch equation gives

$$e_{ff} = - e_{fy} \left(w_f - \frac{1 - w_f e_{fy}}{\phi}\right),$$

where e_{fy} was given in step 3 above and ϕ, the money flexibility coefficient, was taken from Brandow's study as -.86.

6. Estimation of direct price elasticity for nonfood ($e_{50,50}$):

Using the Frisch formula, we obtain

$$e_{50,50} = -e_{50y} \cdot \left(w_{50} - \frac{1 - w_{50} e_{50y}}{\phi}\right)$$

where e_{50y} was given in step 4 above and $\phi = -.86$.

7. Estimation of the cross elasticity showing the effect of nonfood prices on all food consumption (e_{f50}):

Under the homogeneity restriction, we have

$$e_{ff} + e_{f50} + e_{fy} = 0, \text{ or}$$

$$e_{f50} = -(e_{ff} + e_{fy})$$

where e_{ff} was given in step 5 and e_{fy} in step 3.

8. Estimation of the cross elasticity showing the effects of all food prices on nonfood demand (e_{50f}):

From the symmetry relation, we have

$$e_{50f} = \frac{w_f}{w_{50}} e_{f50} - w_f (e_{50y} - e_{fy})$$

where e_{f50} was calculated in step 7, e_{50} in step 4, and e_{fy} in step 3.

9. Estimation of cross elasticities showing the effects of nonfood prices on consumption of individual foods (e_{i50}):

From the Frisch equation we derive

$$e_{i50} = -e_{iy} w_{50} (1 + \frac{e_{50y}}{\phi})$$

where e_{iy} was estimated directly in step 2, and e_{50y} was calculated in step 4.

10. Estimation of cross elasticities showing the effects of individual food prices on nonfood demand (e_{50i}):

The symmetry condition gives

$$e_{50i} = \frac{w_i}{w_{50}} e_{i50} - w_i (e_{50y} - e_{iy}),$$

where e_{i50} was given in step 9, e_{50y} in step 4, and e_{iy} in step 2.

11. Estimation of the cross elasticities showing the effects of all food prices on consumption of individual foods (e_{if}):

Under the homogeneity restrictions we have

$$e_{if} + e_{i50} + e_{iy} = 0, \text{ or}$$

$$e_{if} = -(e_{i50} + e_{iy})$$

where e_{i50} was calculated in step 9 and the e_{iy} was directly estimated in step 2.

12. Estimation of cross elasticities showing the effects of individual food prices on all food consumption (e_{fi}):

The Cournot aggregation gives

$$w_1\ e_{1i} + w_2\ e_{2i} + \ldots + w_{49}\ e_{49i} + w_{50}\ e_{50i} = -w_i$$

From the definition of e_{fi} we have

$$e_{fi} = \frac{w_1 e_{1i} + w_2 e_{2i} + \ldots + w_{49} e_{49i}}{w_1 + w_2 + \ldots + w_{49}}, \text{ or}$$

$$w_1\ e_{1i} + w_2\ e_{2i} + \ldots + w_{49}\ e_{49i} = (w_1 + w_2 + \ldots + w_{49})\ e_{fi}, \text{ and}$$

$$w_i\ e_{1i} + w_2\ e_{2i} + \ldots + w_{49}\ e_{49i} = w_f e_{fi}$$

Hence, the Cournot aggregation becomes

$$w_f\ e_{fi} + w_{50}\ e_{50i} = -w_i \text{ and}$$

$$e_{fi} = -\frac{w_i + w_{50}\ e_{50i}}{w_f}$$

where e_{50i} was calculated in step 10.

13. Estimation of cross elasticities showing the effects of individual food prices on consumption of individual foods in other groups (e_{ij})

$i \neq j$, i contained in I, but j not contained in I:

Consider the ith commodity. For convenience, we assume that the first K commodities belong to the same group. Then, using the homogeneity restriction

$$(e_{i1} + e_{i2} + \ldots + e_{ik}) + e_{ik+1} + \ldots + e_{i49} + e_{i50} + e_{iy} = 0,$$

where the coefficients within the parentheses and e_{iy} were estimated in step 2,

and e_{i50} was calculated in step 9. Now letting R_i be the sum of cross elasticities outside the group under consideration, we have

$$R_i = e_{ik+1} + \ldots + e_{i49}. \text{ Then}$$

$$R_i = -(e_{i1} + e_{i2} + \ldots + e_{ik}) - e_{i50} - e_{iy}, \text{ or}$$

$$R_i = -(e_{i1} + e_{i2} + \ldots + e_{ik} + e_{i50} + e_{iy})$$

The individual cross elasticities e_{ij} outside the group were calculated on the basis of the Frisch relation

$$e_{ij} = -e_{iy}\, w_j\, (1 + \frac{e_{jy}}{\phi}), \text{ and hence}$$

all values on the right-hand side were known, with the sum of the coefficients obtained from the above relation restricted to equal R_i. The values of the individual coefficients e_{ij} were adjusted so that they summed to R_i, while maintaining proportionality to the Frisch relationship. Values for the first row of cross elasticities were calculated by the above method and the coefficients for the first column were calculated by symmetry. Then, the second row was completed and the second column was again calculated by the symmetry relation. This procedure was repeated until a complete matrix of elasticities was obtained.

4.0 Empirical Study: Case of Sri Lanka

In this section the procedure used in this study to construct the matrix of demand elasticities is discussed. The estimates are made in a manner which conforms to restrictions imposed by economic theory. Further, the estimates are made by income group within residency area, since the results are designed to be used in policy decision-making and planning.

The data needs for this endeavor are large. Normally, national aggregate time-series data are used to describe changes in demand over time and thus to estimate price elasticities. Such data are seldom available in de-

veloping countries. However, a recent study has shown that it is feasible to estimate price parameters using household consumption and expenditure survey data.[2] Therefore, it was decided to use available household survey data to estimate the desired relationship.

4.1 Data

The data source for this study is the Socio-Economic Survey of 1969/70 conducted over a twelve-month period for the whole island of Sri Lanka. The survey was designed to provide information on living conditions, and household income and expenditure patterns. Special attention was given to food expenditure and consumption levels. The survey covered 9,700 private households, stratified into 3 geographical areas (urban, rural, and estate), and classified into 6 income groups. Food consumption data was collected by trained interviewers using "a recall list." The interviewers also made daily visits to record food items purchased for seven consecutive days.

4.2 The Food Groups

From a list of some two hundred individual foods, 18 food groups were formed. These groupings were based upon food similarity, budget share, and availability via food aid programs. In this study, the overall category of food includes both alcoholic and non-alcoholic beverages, as well as tobacco and betel. A food group listed as "unidentified" was included for budgetary completeness. However, no other information (food item or quantities) are available for this latter group. Rice was maintained as a single food item commodity group because of its predominance in the Sri Lankan diet. All expenditures for non-food items were aggregated into a single group.

2/ Hassan and Johnson (8) cited a number of empirical studies using budget data and provided a comparison of results obtained by time-series data and by budget data.

4.3 The Estimation Procedure

Demand equations were estimated individually for each food group. The equations were specified with quantities as dependent variables and prices of food commodities and income (expenditure) as independent variables. The unit of observation was the household.

Per capita quantities purchased by the households were used in the estimation equaitons. For food items within groups not expressed in the same quantity units, these were converted into a uniform unit and added together. The sum was then divided by household size. Prices of all commodities are implicit prices, obtained by dividing expenditures by quantities.

Household "income" is the per capita expenditure reported by the household for all food and non-food items and was obtained by summing the expenditure for each item, then dividing by household size.

Two functional forms, linear and double-logarithmic, were used to estimate the parameters for each demand equation. The criteria for selection of the "better" form was based on an overview of the statistical properties, and the expected signs of the individual coefficients.

Due to the small number of surveyed households with purchases in all food groups, a simultaneous equations approach could not be used. Further, it was necessary to estimate the individual demand equations were estimated using two or more "partial" analyses to obtain estimates for all cross elasticities. In each partial analysis equation, estimates were made using quantitiy as the dependent variable own-price and income plus some of the other prices as independent variables. Succeeding estimates used the remaining price variables, retaining own-price and the percapita expenditure. Thus, a number of coefficients were generated for the direct-price and expenditure elasticities. The value used for these coefficients was the average of the coefficients arising from all the partial analyses.

The Estimation was performed one commodity (equation) at a time. Since the coefficient for the cross-elacticities may depend upon its location in the array of all commodities, the commodities were arranged by proportion of total expenditure, w_i. Thus,

$$w_i = p_i q_i \,/\, \sum_{i=1} p_i q_i \qquad i = 1, 2, \ldots, 18, nf$$

and,

$$w_1 + w_2 + - - - + w_{18} + w_{nf} = 1$$

$$w_1 + w_2 + - - - + w_{18} = w_f$$

where w_i = expenditure proportion for commodity i,

p_i = price for commodity i,

q_i = per capita quantity for commodity i,

nf = refers to non-food group, and f refers to all food group.

The elasticity matrix was constucted in the following manner:

(a) Since there was no available information on unidentified foods concerning their nature, quantities, or prices, elasticities could not be calculated. These values were arbitrary set to zero. Unidentified foods were classified into the 18th commodity group. Thus, we have e_{i18}, and $e_{18j} = 0$ for all "i" and "j", and $e_{1818} = 0$, $e_{18y} = 0$, and $e_{y18} = 0$.

(b) The estimation of the elasticities was done on a commodity by commodity basis beginning with rice, the first commodity. The direct-price elasticity (e_{11}), the cross-price elasticities (e_{1j}), and the income elasticity e_{1y} were estimated directly, using two or more equations as described above.[3]

(c) For the second row, the direct-price elasticity (e_{22}), the cross-price elasticities (e_{2j} where j = 3,. 4, ..., 17) and the income elasticity

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[3] It should be noted that the partial equation approach resulted in very small changes in the cross elasticity estimates between equations. This is because of the very low correlation among the prices.

(e_{2y}) were determined in the same manner as for the first row.

(d) The estimation process of (b) and (c) above was repeated until the 17th row for the calculation of direct-price elasticities, cross-price elasticities, and income elasticities was completed.

(e) The income elasticity for all food (e_{fy}) was obtained as weighted average of the income elasticities for individual food items. The weights are the proportions of expenditures on each food items with respect to the total expenditure.

$$e_{fy} = \frac{w_1 e_{1y} + w_2 e_{2y} + \ldots + w_{18} e_{18y}}{w_1 + w_2 + \ldots + w_{18}}, \text{ or}$$

$$= \frac{w_1 e_{1y} + w_2 e_{2y} + \ldots + w_{18} e_{18y}}{w_f}$$

where $w_f = w_1 + w_2 + \ldots + w_{18}$

and e_{1y}, e_{2y}, ..., e_{18y} are as estimated in (b), (c) and (d) above.

(f) The income elasticity for non-food (e_{nfy}) was deduced from the Engel aggregation. According to this restriction, the weighted sum of all the income elasticities is unity with the weights being the expenditure proportion.

Thus,

$$w_1 e_{1y} + w_2 e_{2y} + \ldots + w_{18} e_{18y} + w_{nf} e_{nfy} = 1$$

or,

$$w_{nf} e_{nfy} = 1 - (w_1 e_{1y} + w_2 e_{2y} + \ldots + w_{18} e_{18y}).$$

From (e) above, we have,

$$w_{nf} e_{nfy} = 1 - w_f e_{fy},$$

or,

$$e_{nfy} = \frac{1 - w_f e_{fy}}{w_{nf}}$$

(g) The cross-price elasticities in the columns were calculated by the symmetry condition from those in the rows. This was done to assure adherence to the theoretical conditions. Thus, for the first column, second row, the cross-price elasticity (e_{21}) is computed from the cross-price elasticity (e_{12}) in the first row, second column. Under Slutsky's condition, we have:

$$e_{21} = \frac{w_1}{w_2} (e_{12}) + w_1(e_{1y} - e_{2y}), \text{ or in general}$$

$$e_{j1} = \frac{w_1}{w_j} (e_{1j}) + w_1(e_{1y} - e_{jy}),$$

where w_1 and w_j are expenditure proportions, e_{1j} and e_{1y} were estimated in (b), and e_{jy} in (c) or (d) above.

(h) The process of calculating the cross-price elasticities in the succeeding columns was performed in the same manner.

(i) The cross-price elasticities showing the effects of aggregate food price on individual food quantities (e_{if}) was calculated as the sums of all prices elasticities in the ith row. Thus,

$$e_{if} = e_{i1} + e_{i2} + \ldots + e_{i18} \qquad (i = 1, 2, \ldots, 18)$$

where e_{ij}'s were estimated by the above steps.

(j) The cross-price elasticities showing the effects of non-food prices on individual food quantities (e_{inf}) were calculated by the homogeneity restrictions. Under this restriction, we have,

$$e_{if} + e_{inf} + e_{iy} = 0.$$

Thus,

$$e_{inf} = -(e_{if} + e_{iy}).$$

(k) The cross-price elasticities showing the effects of individual food prices on all food (e_{fi}) were the symmetries of cross-price elasticities showing the effects of all food prices on individual foods (e_{if}). We have

$$e_{fi} = \frac{w_i}{w_f} (e_{if}) + w_i(e_{iy} - e_{fy}),$$

where w_i and w_f are expenditure proportions, and

e_{if} is determined in (i),

e_{iy} is determined in (b), (c) or (d), and

e_{fy} is determined in (e).

(l) The cross-price elasticities showing the effects of individual food prices on non-food group (e_{nfi}) were calculated as the symmetries of the cross-prices elasticities showing the effects of non-food prices on individual foods (e_{inf}). Thus,

$$e_{nfi} = \frac{w_i}{w_{nf}} (e_{inf}) + w_i(e_{iy} - e_{nfy})$$

where w_i and w_{nf} are expenditure proportions,

e_{inf} is determined in (j),

e_{iy} is determined in (b), (c) or (d), and

e_{nfy} is determined in (f).

(m) The direct-price elasticity for all food (e_{ff}) was calculated as the sum of elasticities showing the effects of individual food prices an all food:

$$e_{ff} = \sum_{i=1}^{18} e_{fi}$$

where e_{fi} was estimated as in (k).

(n) The cross-price elasticity showing the effect of non-food price on all food (e_{fnf}) was deduced from the homogeneity condition. Thus,

$$e_{fnf} = -(e_{ff} + e_{fy}),$$

where e_{ff} is determined in (m), and e_{fy} in (e).

(o) The cross-price elasticity showing the effect of all food price on non-food group (e_{nff}) was the symmetry of e_{fnf} obtained above. Thus,

$$e_{nff} = \frac{w_f}{w_{nf}} (e_{fnf}) + w_f(e_{fy} - e_{nfy}),$$

where w_f and w_{nf} are expenditure proportions, e_{fy} was obtained in (e), and e_{nfy} in (f).

(p) The direct-price elasticity of non-food (e_{nfnf}) was deduced from the homogenity condition. Hence,

$$e_{nfnf} = -(e_{nff} + e_{nfy}),$$

where e_{nff} was obtained in (n), and e_{nfy} in (f) above.

5.0 The Findings

The findings are the preliminary (and partial) results of our analysis. Additional analyses are currently underway. All the results obtained to this data are presented in the Tables in the Appendicies. Because of the detail and volumn, no attempt will be made to discuss each table individually. Rather, certain aspects of the results of particular relevance to development policy decisions are discussed in the following section. Here, it is sufficient to point out that while a few of the estimates obtained are clearly unreasonable, the majority appear to be both reasonable in magnitude and internally consistent.

5.1 Policy Analysis

The objective of this section is to illustrate the utility of the information derived from the analysis. Readers are reminded that while actual data will be discussed, there are still a few problems with a numerical results that remain to be resolved. However, it is now clear that these can be resolved with additional work. Thus, while the results are still preliminary and subject to change as refinements are introduced into the methodology, they are presented in the interest of more clearly illustrating the potential utility of this analysis for policy decisions. It should be noted that care must be taken not to ascribe the results per se to a present day developing economy, even the economy of Sri Lanka. The study is out of date, taken at a time when Sri Lanka had a very different market structure than exists today, and thus does not reflect current circumstances. The extent to which the results can be generalized to other LDC economies is not yet known.

To illustrate the policy relevance of the results, a series of examples will be used. These examples will cover three points. First, the "total net nutritional change" information of direct relevance to policy decisions will be presented. Secondly, at this stage in the development of the procedure, it is important to point out how a detailed analysis of the preliminary results can be used to derive improved estimates for use in future work. Third, use of the analysis to gain insight into the impact of capital improvement projects will be illustrated.

In Sri Lanka, as in many LDC's, an official price structure for food commodities exists. Such prices are subject to change with the prevailing politics of the time. The importance of these price changes lies in their impact on consumption (and production) of food commodities. The procedure

discussed in this paper can provide estimates of the nutritional and agricultural impact for any combination of price changes.

As an example, let us assumed that a change in the official price structure is being considered. A relevant question then becomes, "What nutritional impact will a given price change have on the identified groups?" Preliminary results for several price change scenarios are given in Table 1.

The data in Table 1 shows that for Scenario 1, a 10% increase in the price of rice, there will be a net decrease of 18 calories per capita per day for consumers in Urban Income Group II. Further, the protein consumption of this group decreases by nearly 0.4 grams per capita per day. These figures are not large and indicate that for reasonable changes in the price of a stable food, consumers in Urban Income Group II make substitutions among the food groups such that their caloric and protein intake is approximately maintained.

It is instructive to take a detailed look at the food substitutions as calculated from the data. The 10% increase in the price of rice only leads to a series of changes in the quantities of all the other foods demanded/consumed via the cross elasticity values. As expected the quantity of rice, and hence the caloric consumption, decreases with the price increase in the amount of 33.6 calories/capita/day. However, this is almost exactly offset by the increase in consumption of Nuts and Fruits amounting to 32.8 calories/capita/day. Decreased consumption of Other Grains reduces intake of calories/capita/day by 25.0. Other changes in consumption are of lesser magnitude and may be noted in Table 1, with the net effect being the decrease of 18 calories/capita/day perviously mentioned.

Interestingly, the changes in the level of consumption among the food

Table 1 : Urban Income Group II Change in Protein and Calorie/Capita/Day Given a 10% Increase in the Price of Selected Food Commodities and the Change in Cost for Protein and Calories

Food	Senerio 1 $\Delta P = 10\%$ Rice		Senerio 2 $\Delta P = 10\%$ Rice, Bakery Other Grains		Senerio 3 $\Delta P = 10\%$ Rice, Bakery, Spice Tobacco, Other Grains, Cooking Oil	
	Change in Cal/Cap/Day	Change in Gr.P./Cap/Day	Change in Cal/Cap/Day	Change in Gr.P./Cap/Day	Change in Cal/Cap/Day	Change in Gr.P./ Cap/Day
Rice	-33.6	-.628	-36.9	-.686	-60.2	-1.119
Spice	-1.7	-.138	-3.3	-.268	-11.5	-.924
Bakery	6.2	.140	-38.7	-.874	-54.9	-1.240
Fish	1.0	.195	-0.1	-.026	1.5	.284
Vegetables (leafy, roots, and pulses)	-2.4	-.102	3.2	.133	5.4	.227
Sugar	3.5	.005	-10.6	-.140	-4.1	-.054
Nuts, Plantians, and Other Fruits	32.8	.534	20.2	.341	24.6	.007
Tobacco	--	--	--	--	--	--
Other Grains	-25.0	-.683	11.0	.299	-125.4	-3.420
Milk	0.5	.023	3.8	.181	2.2	.104
Meat	-0.7	-.143	-0.9	-.199	0.6	.127
Food (eaten away from home)	(unknown)	(unknown)	(unknown)	(unknown)	(unknown)	(unknown)
Alcoholic Drinks	-1.7	--	-2.4	--	11.1	--
Cooking Oil	-1.5	--	-7.0	--	-4.7	--
Beverages	-0.1	-.015	-0.6	-.139	-0.5	-.120
Eggs	4.9	.366	-25.0	-1.855	-31.7	-2.350
Chewing Nuts and Betel	-0.6	-.015	-0.6	-.014	-0.1	.006
Total Net Change	-18.4	-.398	-87.9	-3.250	-247.5	-8.07
Change in Cost	-.0185/100 Cal	+.0031/Gr.P.	-.040/100 Cal	+.0112/Gr.P	+.0874/100 Cal	-.031/Gr.P.

commodities results in a very similar protein substitution pattern. The decrease in protein consumption from Rice is nearly offset by the increase from Nuts and Fruits. About half the decrease due to Other Grains is offset by the increase in eggs. The other changes in protein consumption are smaller in magnitude and sum to the 0.4 grams/capita/day decrease noted above.

There are several additional points worth noting. First, the change in relative cost of calories and protein after the price change is also shown in Table 1. While all the food group nutrient cost changes are small, the net change in cost per 100 calories is slightly negative. This means that consumers in Urban Income Group II respond to the 10% increase in the price of Rice by purchasing a combination of foods which, on the average, provide slightly less expensive calories than those consumed before the price change. However, the cost per gram of protein from these same foods increased slightly.

While not actually analyzed here, the procedure can be used to assess the quality of the protein consumed before and after changes induced by the price increase in rice. From the information on changes in consumption of the food groups, and other data that were obtained in the survey it is possible to disaggregate the food groups used here into individual foods. This would permit the calculation of changes in protein quality that might result from a price change. It would also be possible to estimate the change in the intake of other nutrients such as Vitamins A and C.

A further point is implied in the discussion above. When the calculations indicate that changes in the relative quantities of foods consumed will take place, the assumption is made that these foods are available in the market place or can be produced quickly in the needed amounts. For

relatively small changes, e.g. the change in the price of one staple food, there may be little or no problem. However, for larger shifts in the quantities demanded, this assumption may not hold. Hence, the question arises as to the availability of a marketable quantity to meet the anticipated demand.

This amount can be readily calculated from the information in this analysis since the changes in quantities demanded/consumed are per capita per day values. Because the proportion of the population represented by Urban Income II, and all other income groups is known, the total quantity needed for any time period can be estimated. If this amount is larger than previous production (or marketable surplus) figures, a project to expand production, (or marketed quantities) will be needed. This is critical information if agricultural and food/nutrition policy are to be integrated.

In addition to the information needed for integrating agricultural and food policy, important data may also be generated for insight into possible import needs. For example, if needed market quantities cannot be domestically produced in the short-run, then importation may be a solution. Since the total quantities needed can be estimated, the required foreign exchange can also be estimated. Thus, the implications of a change in food prices can be traced through to the impact on foreign exchange. If imports are rejected as a solution, the price of the demanded but unavailable food will rise, decreasing the quantity consumed and resulting in a larger caloric deficit. 1/

1/ Note: The impact of changed market prices on domestic supplies has not yet been incorporated into the analysis. Work on this aspect is currently underway.

To this point the discussion has centered on the simplest case, i.e. the impact of a change in price of a single food staple. Suppose, however, the prices of several food groups are changed as a result of a government policy decision. As a specific examples, in Scenario 2 it is assumed that the prices of Rice, Bakery, and Other Grains are each raised by 10%. In Scenario 3, the prices of Rice, Bakery, Other Grains, Spices, Tobacco, and Cooking Oil are raised by 10% each. These three scenarios, while arbitrary in this case, can be used without loss of generality (with respect to price changes or food selected), to illustrate the utility of the analytical procedure for obtaining policy relevant information.

Referring to Table 1, it is instructive to compare the changes in caloric and protein consumption induced by the three scenarios. Considering the total net change figures first, the relatively small decrease of 18.4 calories/capita/day in the first (Δ P = 10% increase for rice only) scenario contrasts with decreases of 87.9 and 247.5 calories/capita/day for the second and third scenarios respectively. Recall that this information is for Urban Income Group II, the second lowest income group for which estimates could be made. Households in this income group may be assumed to have some, but not much, slack in their household budgets. That is, some expenditures are for other than absolute necessities. It is interesting to note what appears to be an effort to maintain their prior level of food intake in terms of calories.

The drop in calories from scenario 1 to scenario 2 is 70/capita/day, while the drop from scenario 2 to 3 is 160 calories/capita/day. Note further that the cost of calories decreases in scenarios 1 and 2, then increases in scenario 3. Exactly the opposite occurs for protein. This implies that Group II consumers are quite economic with respect to caloric intake, but

that overall quality of the protein consumed may decrease in scenario 3 as compared to scenarios 1 and 2.

To place these caloric changes in perspective, we note the level of recommended caloric intake at the time of the study was given by the Sri Lanka government as 2,200 calories/capita/day. The intake level calculated from the same data used in this analysis gives the average for Urban Income Group II as 2,067 calories/capita/day. Thus, even small decreases in calorie consumption can be considered serious.

The procedure can also be used to obtain information on the relative shifts in food demand/consumption which occur among the income groups. As has been pointed out, the present data are preliminary; meaning that not all the estimates are the best obtainable. Such estimates can produce improbable results and the discussion below incorporates an example of the internal data checking needed before final results are released.

To illustrate relative demand/consumption shifts among income groups, Urban Income Group II discuss previously will be compared with Urban Income Group IV. Published information from Sri Lanka lists the average caloric intake per capita per day as 2,340 and total protein as 54.8 grams per capita per day for Group IV. The recommended minimum levels are 2,200 and 48 for calories and grams protein respectively.

Considering the total net change in Table 2, Income Group IV shows a much larger drop in both calorie and protein consumption than Income Group II. While Group IV is above the minimum levels and is better able to withstand a decrease in consumption than Group II, the decrease of 586 calories/capita/day due to a 10% increase in the price of Rice, Bakery and Other Grains, is clearly an over estimate. Such a large decrease would put the average caloric intake of Group IV below that of the lowest income group.

Table 2

Change in Calories and Protein by Food Group

ΔP = 10%
Rice, Bakery, Other Grains

	Urban Income II		Urban Income IV	
	Change in Calories	Change in Protein	Change in Calories	Change in Protein
Rice	-36.9	-.686	-62.8	-1.17
Spice	-3.3	-.268	25.1	2.0
Bakery	-38.7	-.874	-74.5	-1.68
Fish	-0.1	-.026	15.8	3.0
Vegetables*	3.2	.133	-0.3	-0.01
Sugar	-10.6	-.140	169.9	2.23
Nuts, Plantains and Other Fruits	20.2	.341	269.1	5.0
Tobacco	---	---	---	---
Other Grains	11.0	.299	-895.3 (-89.5)	-24.4 (-2.44)
Milk	3.8	.181	-26.9	-1.29
Meat	-0.9	-.199	-18.4	-3.86
Food (eaten away from home)	unknown	unknown	unknown	unknown
Alcoholic Drinks	-2.4	---	-44.6	---
Cooking Oil	-7.0	---	16.4	---
Beverages	-0.6	-.139	-0.5	-0.10
Eggs	-25.0	-1.855	12.3	-0.91
Chewing Nuts and Betel	-0.6	-.014	0.5	0.01
Total	-87.9	-3.25	-586 (+172.7)	-19.3 (-0.77)

* Includes leafy and root vegetables, plus pulses.

Clearly, this is an improbable result that implies errors in the basic coefficients estimated by the procedure.

To determine the source of the problem, the caloric changes of the individual food groups can be examined. We note immediately the very large change of -895.3 calories/capita/day attributed to Other Grains. Clearly this is a suspect figure. Pursuing the point further, the -895.3 figure is calculated from the estimates of the change in the average quantity of Other Grains consumed by households in Group IV. This, in turn, is the sum of the own- and cross-price elasticities. (The income elasticity has no impact since it is assumed household income levels are constant for this analysis.) Since only the prices of Rice, Bakery, and Other Grains have been allowed to vary in this example, we have only to look at the cross-price elasticities of Other Grains with Rice and Bakery, and the own-price elasticity of Other Grains. We found the cross-price elasticity for Other Grains and Bakery to be too large in comparison to the other values but that the sign is as expected. (Interested readers are referred to the elasticity matrix for Urban Income Group IV in the Appendix.) Thus, it is possible to identify elasticity estimates which contribute to questionable total net change results and to re-examine these values before the final analysis are made.

It should be noted here that in two previous attempts by well known researchers to estimate full elasticity matrices, it was necessary to use "assigned" values for certain foods. This may become necessary in this analysis. However, because nutrient intake tests of reasonableness can be applied to the consumption of food as calculated from the elasticity estimates, and because these tests are independent of the estimation procedure, it becomes possible to replace an invalid elasticity estimate with

an assigned value that meets both the theoretical restrictions and the reasonableness tests. In this sense, the extension of the food demand estimates into nutritional intake estimates provides a more powerful check on the validity of the elasticity estimates than would otherwise be possible.

In terms of the current example, the estimate in question appears to be off by a factor of 10. Although the new assigned value must be chosen and other values adjusted to meet the theoretical restrictions, an approximation of the revised results can be obtained by reducing the questionable nutritional intake value by a factor of 10. This has been noted in Table 2 by placing the assigned values and resulting new totals in parentheses. The tentative results suggest that in Income Group IV, caloric intake actually increases while protein intake is virtually unchanged.

Tentatively, then the results suggest that the 10% increase in the price of Rice, Bakery, and Other Grains, would result in a decrease in both caloric and protein intake in Urban Income Group II, but that these same price changes would result in Income Group IV increasing caloric intake with no change in protein consumption. (Recall that Income Group II is below recommend caloric intake levels while Group IV is above this level.) Whether such a result is consistent with overall national or program objectives is left to the reader's judgement.

In summary, using the procedure to compare the potential impacts of food price policy decisions on and across residence income groups provides information relevant to the following policy areas. First, it is possible to determine the nutritional impact a policy decision (i.e. a price change) can be expected to have on a given consumer group. Second, whether the nutritional impacts are uniformly distributed across consumer groups, or in selected groups can be asertained. Third, it is possible to assess the

extent to which benefits fall to the "needy" consumer groups. Fourth, judgements regarding the capability of domestic production to fill new demand levels can be made. If production assistance is needed, the data are quite explicit regarding how much of which food crops must be available. Production projects can then be designed accordingly. Fifth, if the new demand must be met via imports, estimates of the amount of foreign exchange needed can be made.

The discussion to this point has centered on tracing the ramifications of price policy. Let us now turn our attention to the investigation of the impacts of developmental projects. For present purposes we will investigate the two broad categories of income generating and food production increasing projects.

Initially, we will assume that two large capital improvement projects are being proposed, a road building project and an irrigation system. To simplify the discussion only the main effect of each project will be analyzed. For the road building project, this is the additional cash income earned by the workers, and for the irrigation system, the increased production.

Once the engineering planning work has been completed for the road building project, the number of workers and wage rates needed will be known fairly accurately. From this information, an estimate can be made of the number of households within the identified income groups which these workers represent. With this information and data from the analysis, we can estimate the number of persons who will benefit nutritionally from the increased income. Further, the magnitude of the nutritional improvement can be estimated. Such an estimate could then be compared with a "work for food" scheme with respect to total nutritional gains and cost/nutrient gained.

As an example, suppose Rural Income Group I and II each contribute 1/2 of the workers employed on the road building crews. Suppose further that the average increment to income, versus alternative employment opportunities, is 15% for Rural Income Group I and 10% for Group II. The preliminary results shown in Table 3 indicate that households represented by Group I workers would increase their average daily per capita caloric intake by 309. For households in Group II the figure is 160.

These figures represent substantial gains for the individuals in the households involved. For Rural Income Group II, average daily caloric consumption was found to be 2,326. Hence, the addition of 160 calories/capita/day brings the Group II average well above the recommended level of 2,200. For Rural Income Group I, the average daily caloric consumption was found to be 2,099. With the addition of 309 calories/capita/day, the average of this group rises to 2,408, which is well over the recommended daily consumption level. Whether these gains are larger or smaller, and whether the costs are more or less favorable as compared to a Work for Food project could also be calculated.

It is informative to note the difference if the road workers were recruited from urban, as opposed to, rural areas. Recall that the Urban Group II average daily caloric consumption was found to be 2,067. Hence, the addition of 190 calories/capita/day brings the Group II average to 2,257 or just 57 calories/capita/day over the recommended level of 2,200. For Urban Income Group I, the average daily caloric consumption was found to be 1,901. With the addition of 234 calories/capita/day, the average of this group rises to 2,135, which is still 65 calories/capita/day under the recommended daily consumption level. Clearly, this information has implications regarding the recruitment of laborers.

Table 3

Change in Calories/Capita/Day
Due to:

	+10% Income	+15% Income
Rural I	220	309
Urban I	205	234
Rural II	160	220
Urban II	190	262
Rural III	182	216
Urban III	218	245
Rural IV	178	186
Urban IV	215	255
Rural V & VI	217	267
Urban V & VI	175	214

Table 4

Change in Calories/Capita/Day
Resulting from a 3% Increase
in the Total National Production
of Rice, Vegetables, and Other Grains

	Urban Income I	Urban Income II
Rice	14.5	1.0
Spice	-0.1	1.7
Bakery	21.8	-24.8
Fish	2.4	0.2
Vegetables*	4.2	2.0
Sugar	-6.1	-12.8
Nuts, Plantains, and Other Fruits	15.3	7.3
Tobacco	--	--
Other Grains	155.6	56.6
Milk	9.3	1.0
Meat	0.7	1.8
Food (eaten away from home)	--	--
Alcoholic Drinks	-5.7	1.7
Cooking Oil	-1.0	1.0
Beverages	0.0	1.1
Eggs	-57.6	2.5
Chewing Nuts and Betel	-0.2	-0.3
Totals	153.1	33.6

*Includes leafy and root vegetables, plus pulses

Information from this analysis can also be used to analyze the nutritional impact of agricultural production projects. Assume that a proposed irrigation scheme is projected to increase the total national production of Rice, Vegetables, and Other Grains by 3% each. A useful piece of information in the planning and evaluation stages would be the nutritional impact of the project.

To analyze this impact, it is necessary to estimate the influence the increased quantities of Rice, Vegetables, and Other Grains will have on the prices of all food commodities. The only meaningful method of accomplishing this is to compute a National Level Elasticity Matrix as the weighted sum (by population share) of the individual residence/income group demand matricies. Such a matrix has been computed and is included in the tables appended to this report. From this matrix, and the mathematical relationship between quantities and prices, it becomes possible to estimate the price changes in all food commodities given the projected change in the quantities produced of any combination of foods. These new (estimated) prices, derived at the national level, are then used in the individual residence/income group demand matricies to estimate changes in actual quantities consumed and hence in nutritional intake.

Some of these results are shown in Table 4. Here, we note that the lowest income group, Group I, records a substantial increase of 153 calories/capita/day, while Group II shows only a marginal increase of 33.6. Further, the increase for both groups derives mainly from Other Grains, as opposed to either Rice or Vegetables, even though the increased quantities of these two foods decreased their market prices. Hence, it would appear that for the nutritional benefit of these two low income groups, the major impact comes from the increased supply of Other Grains. Analyses

of the remaining income groups is in process.

The above discussion has focused on the impact of increased domestic production. It should be noted that with respect to the functioning of the market, the source of the supply increase is immaterial. In particular, the above example could just as well be used to analyze the impact of P.L. 480 shipment. Hence, the 3% supply increase is now due to P.L. 480 supplies rather than domestic production. Otherwise, the analysis and findings are identical.

Used in this manner, insight can be gained into the expected nutritional impact of specific or anticipated food aid programs and judgements made regarding the desirability of alternative food aid packages. For example, if the major caloric gain for the lower income groups comes from Other Grains, then the following points become germain with respect to food aid. First, if shipments of rice (or wheat) do not benefit the low income groups as much as would equal quantities of Other Grains, then, secondly, is it possible to design a program where these groups can get maximum benefit from P.L. 480, shipments? A possibility is to use the funds generated from the sale of P.L. 480 commodities to increase the market supply of Other Grains either through purchases of domestic production or via commercial imports. The effect of such a program would be to transfer the food aid subsidy from a P.L. 480 commodity which does not provide the desired level of benefit for the needy, to another (domestic?) commodity which provides more nutritional benefit to the target groups. However, irrespective of the nature of the program, it is essential to have the detailed information provided by this analysis to assure the targeted groups do in fact benefit.

These latter examples, then, provides further evidence of the policy relevance of information derived from this analysis, particularly if there

is a desire to integrate agricultural and food/nutrition policy. Through use of this procedure it is possible to estimate the nutritional impact, by residence/income group, of proposed agricultural production projects or food aid programs.

There is another way to employ this procedure which is as potentially useful as the analysis already discussed. That is to use the procedure in reverse by setting nutritional goals for each residence/income group, then identifying policy decisions or planning projects which meet the stated goals. At the moment, the present analysis is limited to consideration of calories and protein. But as indicated, there is no logical reason why other nutrients can not be brought into the analysis.

To use the procedure is reverse, one would proceed by first setting a desired nutrient consumption level, then systematically providing data on the following questions and points. "Which food commodities provide the needed nutrient(s)?" "What is the cost/nutrient for each commodity?" "What will be the per capita consumption impact of a price change? of increased income?" "For which of these food commodities can domestic production be expanded to needed levels? at what cost? over what time period?" "What will be the net impact of increased marketable quantities on prices and consumption?" Given information on these points, it would be possible to target certain food crops for increased production with the knowledge that the nutritional impact will benefit the targeted groups at the preselected level.

We should re-emphasize, here, that increases in the production of major food crops do not necessarily have a uniform impact either within or across income groups. This was shown in a previous example where Other Grains contributed the majority of the nutritional benefit in the two lower income

groups, although the contribution to total marketable quantities (3%) was equal. It is information of this detail that is potentially very useful for planning and policy decisions of both Development Agencies and LDC governments where the desire is to integrate agricultural and food policy.

One further point can be made. If the irrigation scheme and the road building project are competitive in the sense of funding, information from this analysis would prove useful in determining which (or what level) of each project would provide the maximum nutritional impact for the most needy low income groups.

5.2 FUTURE WORK PLANNED

Additional work is proceeding along three paths; refinement and validation, incorporation of the impact of prices on production (i.e. supply side), and generalization of results. The emphasis in the immediate future will be on fine tuning the current procedure. This will be done both by increasing the detail, and by cross checking the results against historical facts and the results of alternative estimation procedures.

The results presented above are limited to a discussion of the various impacts involving consumption. An important addition to the model will be the incorporation of the impact on domestic food production of various policy and developmental options. Obviously, a food price policy decision has ramifications for both consumption and production. The full integration of agricultural and food policy requires information on both aspects. Considerable work toward integration of the production side has already been done. The primary remaining tasks are specification of a dynamic system and setting up the associated computer program.

However, the real pay off will come with the analysis of a current

data set from an LDC country which is ready to put the information to full use. Such opportunities are now in the discussion stage. When the analysis of several countries has been completed, then a point-by-point comparison of results can be made. Then, and only then, will it be possible to determine the extent to which results from one country may be useful in another country.

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APPENDICES

CHANGE IN CALORIE/CAP/DAY

Residence and Income Group	Δy (income)			Δp (price)		
				Rice, Spice Bakery, Tobacco Grains, Oil	Rice, Bakery Grains	Rice
	+10%	-10%	+15%	+10%	+10%	+10%
Urban II	+195	-195	+262	-155	-121	-0.5
Rural II	+160	-160	+220	-143	-180	-97.0
Urban III	+212	-212	+237	-51.3	-189.0	-92.2
Rural III	+182	-182	+216	-191.0	-313.0	-23.9
Urban IV	+220	-220	+272	+12.9	-23.1	-104.2
Rural IV	+175	-175	+168	--	--	--

Coefficients of Income (Expenditure) Elasticity of Demand
by Sector and Income Group--Sri Lanka
(Logarithmic functions)

Food Group	Income Group I		Income Group II		Income Group III		Income Group IV		Income Groups V & VI	
	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural
Rice	.3137	.7867	.4572	.4354	.4062	.3257	.5034	.1740	.1601	.2020
Spice	.5837	.5112	.5070	.5029	.4821	.3667	.4409	.3866	.2425	.2422
Bakery	.5460	.2356	.2230	.2236	.5348	.5212	.4542	.6330	.3333	.4224
Fish	.5949	.5070	.6126	.6474	.4082	.5813	.2907	.3739	.2680	.3462
Vegetables	.3821	.5381	.5106	.4298	.4636	.3356	.3933	.0248	.2891	.4220
Sugar	.4473	.7455	.3792	.4166	.2614	.2382	.3488	.1358	.2885	.2068
Fruit	.4395	.1752	.5724	.4469	.5745	.4537	.3681	.2618	.2921	.4570
Tobacco	.8382	.4673	.9913	1.0234	.4873	1.0167	.1712	1.1041	.1878	.0119
Grain	.5572	.1800	.2860	-.0058	.1983	-.1099	.0730	.1593	.1176	.5735
Milk	.4746	.6936	.7081	.5285	.5979	.7574	.4726	.6062	.3558	.1810
Meat	.6577	.9759	.5334	.4891	.5268	.4849	.3455	.5913	.3647	.3452
Food (away from home)	.4188	.8410	.9225	.7235	.5125	.5209	.2577	.2262	.1891	.5160
Alcohol	1.0363	1.2882	.9486	.5004	.4203	.8693	.4794	2.0135	.6853	.5213
Oil (cooking)	.5697	.8997	.5732	.8253	.7011	.5161	.5292	.7774	.4115	.4235
Beverages (non-alcoholic)	.3687	.6235	.5840	.7106	.5689	.3249	.5024	.3039	.5140	.3892
Eggs	.4621	.5966	.9904	.5531	.8266	.5934	.5994	.6597	.4225	.6081
Chewing nuts and leaves	.8029	.4493	.5612	.4620	.1727	.3887	.0045	.1939	.1852	.1441

Comparison of
Coefficients of Income Elasticity of Demand
Sri Lanka

Food	FAO Income Elasticity	Our Market Level
Rice	0.6	.57
Wheat	0.4	.13 (other grains
Sugar	1.0	.52
Vegetables	0.5	.46
Fruit	0.8	.35
Meat	0.5	.69
Eggs	1.5	.61
Fish	0.8	.56
Milk	1.2	.63
Oil	1.0	.78

Source: FAO, Agricultural Commodities Projections for 1975 and 1985. Volume 2: Methodological Notes Statistical Appendix, Rome, 1967, pp. 32 - 33.

Change in Calories/Capita/Day
Due to:

	+10% Income	+15% Income
Rural I	220	309
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Rural II	160	220
Urban II	190	262
Rural III	182	216
Urban III	218	245
Rural IV	178	186
Urban IV	215	255
Rural V & VI	217	267
Urban V & VI	175	214

Coefficients of Own-Price Elasticity of Demand
by Sector and Income Group--Sri Lanka
(Logarithmic functions)

Food Group	Income Group I		Income Group II		Income Group III		Income Group IV		Income Groups V & VI	
	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural
Rice	-.3045	-1.386	-.3931	-.7610	-.9166	-.8236	-.4404	-.0228	-.6123	-.3737
Spice	-.6612	-.6568	-.7139	-.6678	-.4859	-.7559	-.8072	-.7418	-.4160	-1.1497
Bakery	-.8203	-.5034	-.7423	-.4025	-.3698	-.1757	-.2156	-.4658	-.1480	-.4218
Fish	-1.1514	-1.1670	-.7142	-.9284	-.9034	-.4138	-.9483	-.8247	-.8992	-.5995
Vegetables	-.7374	-.6396	-.6020	-.8750	-.6719	-.6435	-.7742	-.3631	-.6275	-1.3563
Sugar	-1.0507	-1.3612	-1.0493	-1.0334	-1.1102	-1.0224	-1.1111	-.9313	-1.0814	-1.0102
Fruit	-1.1727	-1.1158	-.9733	-.9624	-1.2326	-.6417	-1.1739	-1.2648	-.9234	-1.3007
Tobacco	-.8242	-.9490	-.9247	-1.0098	-.9079	-.7791	-.7192	-.9275	-.9636	-1.7051
Grain	-.6043	-.5393	-.4894	-.6981	-.1257	-.3675	-.2461	-.1736	-.7595	-2.0246
Milk	-.6212	-.1317	-.2342	-.6030	-.3983	-.0741	-.2612	-.1998	-.6520	-.4978
Meat	-.3381	-.3289	-.2299	-.1646	-.4882	-.2122	-.3413	-.6506	-.1859	-.4449
Food (away from home)	-.3949	-.3451	-.4641	-.5301	-.3839	-.2040	-.3888	-.7937	-.3471	+.3067
Alcohol	-1.0470	-.8609	-.9420	-.9136	-1.2444	-1.0239	-.6405	-.7275	-1.1226	-.4355
Oil (cooking)	-.2430	-.4772	+.3846	-.6632	+.0695	-.3020	-.4771	+.4579	+.2502	+.1664
Beverages (non-alcoholic)	-.8134	-.9043	-.8421	-.9453	-.8292	-.9549	-.8679	-.7622	-.8428	-.4979
Eggs	+.1484	-.6016	-.3737	-.4119	-.1775	-.8525	-.6715	-1.2161	-.3214	-.2103
Chewing nuts and leaves	-1.0542	-.8522	-1.0695	-.9269	-1.0975	-1.2263	-1.0402	-1.0880	-1.0719	-1.4492

ELASTICITY MATRIX AT NATIONAL LEVEL

(Sri lanka)

	RCE	BPI	BAR	FIS	VEG	SUG	FRU	TOB	GRA	MIL	MEA	FOO	ALC	OIL	NAL	EGG	CHE	Y
RCE	-0.8511	-0.0064	-0.1122	-0.2439	-0.0700	0.0110	0.1590	0.0502	1.1813	-0.1264	0.0110	-0.0628	-0.0398	-0.0081	-0.0179	-0.2801	-0.0621	0.5730
BPI	-0.0100	-0.6806	0.0991	0.0904	0.1168	0.0402	0.0381	0.0154	-0.1494	-0.0442	0.2727	-0.0474	-0.0181	0.0481	0.0276	0.1299	0.0069	0.4637
BAR	-0.3518	-0.0226	-0.4326	0.1216	-0.1426	-0.0891	-0.0314	-0.0164	0.3315	0.0171	0.0460	0.0326	0.0344	-0.0014	0.0540	0.1096	0.1334	0.2946
FIS	-0.4042	0.0827	0.2644	-0.8848	0.1886	-0.0358	0.0829	0.0417	-0.0147	0.2900	0.2596	-0.1992	0.1086	-0.1705	0.0135	0.4430	0.0299	0.5575
VEG	-0.1044	0.1276	0.0057	0.2063	-0.7258	0.0162	-0.0870	-0.0004	-0.3105	-0.1512	0.0713	-0.0917	-0.0242	-0.0289	-0.0184	-0.8300	0.0503	0.4615
SUG	0.0297	0.0420	-0.1614	-0.0537	0.0271	-1.1036	-0.0113	0.0086	-0.2631	-0.2062	0.0318	0.1119	-0.0913	-0.0202	0.0073	0.3518	0.0189	0.5224
FRU	0.3523	0.0491	-0.0409	0.1477	-0.1160	-0.0110	-1.0071	0.0295	-0.4790	0.0989	0.1559	-0.0546	0.0355	-0.0208	0.0218	0.1223	0.0444	0.3503
TOB	0.1911	0.0288	-0.1540	0.0868	0.0023	0.0151	0.0358	-0.9475	-0.0045	0.2207	-0.3234	-0.2411	0.1726	0.0550	-0.0011	-1.6257	0.1422	0.7535
GRA	8.0425	-0.2921	-0.0933	0.4210	-0.6624	-0.2994	-1.2390	0.0916	-0.5412	-0.1745	0.7607	-0.0848	-1.5941	0.2718	-0.3485	0.2552	0.0016	0.1287
MIL	-2.0393	-0.1686	-0.2115	1.9889	-0.3870	-1.2848	0.1562	0.5446	-0.1809	-0.2899	-0.1663	0.2056	-0.0654	0.0833	-0.0746	0.0300	-0.0341	0.6225
MEA	-2.3939	2.5695	-0.1007	1.0433	0.0168	0.1852	1.4083	-1.8208	0.5726	-0.2072	-0.3085	0.1942	-0.3293	-0.0875	-0.2008	-1.5047	0.6659	0.6822
FOO	-0.3848	-0.0228	0.1354	-1.0543	-0.1599	0.5655	-0.1447	-0.4465	-0.5150	0.1384	0.0680	-0.3622	-0.6007	-0.3056	0.2774	1.9326	0.0728	0.7175
ALC	-0.3112	-0.1073	0.0556	0.6451	-0.1261	-0.4584	0.1733	0.2109	-0.9485	-0.0875	-0.1595	-0.5748	-0.9144	0.2355	-0.0154	-0.8702	-0.0980	0.9475
OIL	-0.0196	0.1952	0.4068	-0.7614	-0.1281	-0.1114	-0.0428	0.0370	0.4714	0.2600	0.0131	-0.1176	-0.1114	-0.2846	0.0577	-0.1101	-0.0586	0.7790
NAL	-0.1155	0.1076	0.2929	0.0606	-0.0761	0.0055	0.0635	0.0239	-0.2000	-0.0693	-0.0277	0.6456	-0.0686	0.0547	-0.8890	-0.0863	-0.0357	0.5990
EGG	-9.3796	6.9825	6.1511	11.6215	-24.4764	8.5527	2.2180	-19.6424	3.6392	-0.1450	-4.0634	8.2848	-4.5118	-1.3878	0.2279	-0.5592	0.0776	0.6103
CHE	-0.5289	0.0738	1.6279	0.1548	0.2318	0.0887	0.1640	0.3161	-0.0044	-0.2616	0.3081	0.5341	-0.1029	-0.0603	-0.0484	-0.5088	-0.9637	0.4383

ELASTICITY MATRIX FOR URBAN INCOME 1

(Sri Lanka)

	OCE	FIS	SPI	VEG	BAK	SUG	FRO	TOB	POO	MIL	MEA	MAL	OIL	GRA	CHE	ALC	NOG	UFO	FOOD	NF	T
OCE	-0.0345	0.4434	0.1658	0.4110	0.2110	0.2639	-0.0555	0.0422	-0.1365	-0.2764	-0.0681	-0.0538	0.0246	0.0344	0.1076	0.0539	-0.6650	0.0	0.2690	-0.5627	0.5157
FIS	0.4661	-1.1514	0.1565	0.0310	-0.4452	-0.1895	-0.0521	0.0769	-0.1067	-0.1779	0.0569	-0.0729	-0.1524	0.2041	-0.0067	-0.1121	-0.7226	0.0	-2.1752	1.5805	0.5949
SPI	0.2011	0.1761	-0.6612	0.0475	-0.0300	0.0742	-0.0566	0.0302	0.0408	-0.0556	-0.1704	-0.0250	0.0007	0.4521	0.0114	-0.0559	-0.3564	0.0	-0.5773	-0.0064	0.5657
VEG	0.4534	0.0520	0.0640	-0.7574	0.1994	0.0472	-0.1703	0.0215	-0.0069	-0.1595	0.2538	-0.0366	-0.2291	-0.2091	0.0423	0.0368	-0.6093	0.0	-0.6362	0.6561	0.5821
BAK	0.5557	-0.6422	-0.0368	0.2056	-0.6205	0.0005	0.1451	0.0511	-0.2644	0.1946	0.5766	-0.2170	-0.3026	0.2067	0.1768	0.5021	-5.9015	0.0	-5.9899	3.4459	0.5660
SUG	0.4640	-0.2840	0.1045	0.0508	0.0052	-1.0507	0.0276	0.0225	0.0561	0.0265	-0.3841	-0.0561	-0.0757	-0.0234	-0.0195	0.0140	-0.2602	0.0	-1.3440	0.6967	0.4475
FRU	-0.1105	-0.0611	-0.0762	-0.2195	0.1684	0.0304	-1.1727	0.0621	0.0812	-0.1885	-0.0071	-0.0271	-0.1480	0.5069	0.0096	-0.0008	-0.5614	0.0	-1.7360	1.2965	0.4395
TOB	0.1101	0.2058	0.0655	0.0306	0.0910	0.0307	0.0945	-0.6242	-0.0999	0.2591	-0.2680	-0.0066	-0.5146	0.5429	0.1423	0.1055	1.6113	0.0	1.7746	-2.6126	0.6382
POO	-0.4427	-0.2965	0.1076	-0.0154	-0.5156	0.1066	0.1584	-0.0954	-0.5949	-0.1367	-0.2585	0.0261	0.9366	-1.9925	0.1365	0.0662	7.0016	0.0	3.2116	-3.6304	0.4168
MIL	-1.2040	-0.6775	-0.1161	-0.4461	0.5163	0.0652	-0.4527	0.5524	-0.1655	-0.6212	-0.1146	-0.0616	-0.1615	-0.0501	0.0049	-0.0598	-1.0865	0.0	-4.5180	5.6434	0.4746
MEA	-0.4555	0.2450	-0.6516	0.7084	1.0971	-1.0597	-0.0230	-0.3695	-0.5557	-0.1275	-0.5561	-0.0102	-0.0227	0.2444	-0.2962	0.2219	-1.0556	0.0	-2.1642	1.5265	0.6577
MAL	-0.1962	-0.3650	-0.1052	-0.1575	-0.7645	-0.1256	-0.0814	-0.0051	0.0442	-0.1081	-0.0097	-0.6154	0.0742	-3.7819	-0.0045	0.0920	0.1366	0.0	-6.1526	3.7861	0.3687
OIL	0.1368	-0.8123	0.0038	-0.6970	-1.1177	-0.2671	-0.4751	-0.5957	1.7572	-0.2258	-0.0288	0.0757	-0.2430	0.6699	-0.0135	0.0255	-1.4853	0.0	-5.4922	2.9225	0.5697
GRA	0.1995	1.1059	2.0549	-0.8300	0.7727	-0.0655	1.6360	0.6665	-3.7955	-0.0715	0.3414	-5.9906	0.6792	-0.6043	0.0627	-0.0882	0.8697	0.0	-1.0577	0.5005	0.5572
CHE	0.6217	-0.0546	0.0610	0.2016	0.6396	-0.0974	0.0520	0.3523	0.3270	0.0055	-0.4865	-0.0092	-0.0195	0.0785	-1.0542	-0.0761	0.1616	0.0	1.0826	-1.8655	0.8029
ALC	0.2642	-0.6057	-0.3960	0.1890	2.6745	0.0556	-0.0176	0.2634	0.2284	-0.1268	0.4056	0.1556	0.0555	-0.1297	-0.0886	-1.0470	-0.5665	0.0	1.2274	-2.2457	1.0363
NOG	-27.5630	-20.5624	-13.7665	-12.5406	-76.0769	-4.7953	-9.4641	16.2497	77.4561	-7.9919	-7.0656	0.7506	-7.6511	4.6598	0.6599	-1.2595	0.1484	0.0	-86.0906	66.4285	0.4421
UFO	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FOOD	0.0255	-0.1875	-0.0380	-0.0543	-0.2444	-0.0771	-0.0919	0.0641	0.1668	-0.1007	-0.0442	-0.1066	-0.0576	-0.0162	0.0167	0.0176	-0.2765	0.0	-1.0082	0.4508	0.5576
NF	-0.0989	0.0751	-0.0521	-0.0089	0.1409	0.0140	0.0293	-0.0747	-0.1359	0.0597	0.0176	0.0705	0.0515	-0.0006	-0.0230	-0.0226	0.2155	0.0	0.0063	-1.5041	1.4976
W	0.0446	0.0395	0.0347	0.0286	0.0273	0.0258	0.0236	0.0141	0.0139	0.0105	0.0094	0.0077	0.0074	0.0075	0.0057	0.0051	0.0014	0.1296	0.4545	0.5655	1.0000

ELASTICITY MATRIX FOR URBAN INCOME 2

(Sri Lanka)

	RCE	FIB	SPI	BAK	VEG	SUG	FRU	TOB	FOO	MIL	MEA	ALC	OIL	MAL	GRA	CHE	EGG	TUFO	FOOD	NF	Y
RCE	-0.3931	0.1150	-0.0944	0.0414	-0.1041	0.0184	0.2958	-0.0766	0.0315	0.0184	-0.0587	-0.0153	-0.1001	-0.0361	-0.0780	-0.0779	0.1584	0.0	-0.3554	-0.1018	0.4572
FIB	0.1176	-0.7142	0.0891	-0.0443	0.0437	-0.0583	0.0386	-0.0226	0.0500	0.0349	0.3672	0.0504	0.1201	-0.0052	-0.0891	-0.0219	0.0622	0.0	0.0382	-0.6508	0.6126
SPI	-0.1292	0.1159	-0.7139	-0.0409	0.0738	0.0422	-0.0384	-0.0147	-0.0168	0.0917	0.1774	-0.0771	0.1164	0.0498	-0.0806	-0.0071	0.1628	0.0	-0.2887	-0.2183	0.5070
BAK	0.0678	-0.0468	-0.0362	-0.7423	0.3081	0.0013	-0.0723	-0.0266	0.1430	0.1315	-0.1719	0.1350	-0.1139	0.0759	0.2523	0.0282	-0.6676	0.0	-0.5365	0.3135	0.2250
VEG	-0.1567	0.0641	0.0812	0.5183	-0.6020	0.0365	-0.1566	-0.0164	-0.0597	0.0031	-0.2224	-0.0633	0.0810	0.0200	-0.1570	0.0737	0.0368	0.0	-0.4994	-0.0112	0.5106
SUG	0.0538	-0.0527	0.0561	-0.0023	0.0445	-1.0493	-0.0190	0.0014	0.0564	0.0601	-0.0572	0.0352	0.0053	0.0069	-0.1342	-0.0219	0.2772	0.0	-0.7617	0.3826	0.5792
FRU	0.5512	0.0690	-0.0551	-0.1029	-0.1991	-0.0252	-0.9753	-0.0078	0.0379	-0.1054	0.0858	-0.0446	0.1376	-0.0106	-0.1092	0.0597	0.2275	0.0	-0.4864	-0.0860	0.5724
TOB	-0.2209	-0.0682	-0.0413	-0.0675	-0.0404	-0.0105	-0.0188	-0.9247	0.0544	-0.3317	-0.0749	0.2636	0.0124	-0.0214	-0.1538	0.2639	-0.9527	0.0	-2.3126	1.3213	0.9913
FOO	0.0750	0.1254	-0.0469	0.2713	-0.0872	0.0857	0.0520	0.0607	-0.4641	0.0155	0.1430	-0.0503	-0.5757	-0.1367	-0.1422	0.1380	-0.1275	0.0	-0.6640	-0.2585	0.9225
MIL	0.0489	0.0991	0.2076	0.2746	0.0019	0.1048	-0.1785	-0.5901	0.0193	-0.2542	-0.8511	-0.2714	0.0229	-0.0291	0.0535	0.0418	-0.6419	0.0	-1.7019	0.9958	0.7081
MEA	-0.2316	1.3408	0.5118	-0.4736	-0.5837	-0.1354	0.1748	-0.1046	0.1970	-1.0323	-0.2299	-0.1453	0.1206	0.0467	0.5823	-0.0225	-0.8637	0.0	-1.0466	0.5132	0.5534
ALC	-0.0940	0.2251	-0.2979	0.4459	-0.2237	0.0868	-0.1262	0.5014	-0.0873	-0.4369	-0.1880	-0.9420	0.5598	0.0422	-0.4888	-0.0986	-0.7214	0.0	-1.8435	0.8949	0.9406
OIL	-0.5801	0.6471	0.4944	-0.4641	0.3119	0.0140	0.4218	0.0326	-1.1577	0.0456	0.1776	0.6450	0.5846	0.0967	-1.7538	-0.0307	0.1166	0.0	-0.5806	0.0074	0.5732
MAL	-0.2156	-0.0275	0.2138	0.2999	0.0769	0.0197	-0.0333	-0.0420	-0.2716	-0.0529	0.0696	0.0518	0.0982	-0.8421	-2.0788	-0.0174	-0.2097	0.0	-2.9610	2.5770	0.5840
GRA	-0.5892	-0.6246	-0.4498	1.3367	-0.8002	-0.6049	-0.4388	-0.4353	-0.3663	0.1350	0.7502	-0.7392	-2.3239	-2.7097	-0.4894	-0.1117	-3.7114	0.0	-12.1722	11.8862	0.2860
CHE	-0.8581	-0.2228	-0.0591	0.2068	0.5423	-0.1461	0.2322	1.1026	0.5262	0.1479	-0.0635	-0.2130	-0.0584	-0.0325	-0.1618	-1.0695	-0.8515	0.0	-0.9784	0.4172	0.5612
EGG	2.1197	0.7723	1.6154	-6.2839	0.3227	2.2049	1.6284	-4.7711	-0.5942	-2.7683	-2.9938	-1.9425	0.2710	-0.4864	-6.5696	-1.0494	-0.3737	0.0	-18.8983	17.9079	0.9904
TUFO	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FOOD	-0.0202	0.0130	-0.0101	-0.0290	-0.0194	-0.0312	-0.0137	-0.0547	-0.0091	-0.0550	-0.0174	-0.0225	-0.0057	-0.0352	-0.1165	-0.0057	-0.1004	0.0	-0.5126	0.2177	0.2949
NF	-0.0489	-0.0732	-0.0407	-0.0202	-0.0275	-0.0112	-0.0233	0.0250	-0.0149	0.0109	-0.0012	0.0071	-0.0065	0.0211	0.0990	-0.0009	0.0880	0.0	-0.4513	-1.2016	1.6529
W	0.0551	0.0528	0.0260	0.0244	0.0236	0.0208	0.0187	0.0133	0.0121	0.0112	0.0090	0.0070	0.0061	0.0060	0.0046	0.0032	0.0026	0.2235	0.4808	0.5192	1.0000

ELASTICITY MATRIX FOR URBAN INCOME 3

(Sri Lanka)

	RCE	BAK	FIS	SPI	VEG	SUG	FRU	TOB	MIL	MEA	FOO	OIL	ALC	BAL	EGG	GRA	CHE	UFO	FOOD	NF	Y
RCE	-0.9164	0.0127	-0.0750	0.1792	-0.1299	0.0005	-0.0483	0.1105	-0.1413	0.1949	-0.0700	-0.0441	-0.0858	0.1022	0.3736	-0.0051	-0.0964	0.0	-0.5497	0.1435	0.4062
BAK	0.0067	-0.3698	0.3953	0.0815	0.5847	0.0409	0.2521	-0.1065	0.0093	-0.1444	-0.0744	-0.0559	-0.2043	0.4009	-2.7088	-0.3856	0.2762	0.0	-2.2819	1.7271	0.5348
FIS	-0.0715	0.5040	-0.9034	0.2854	0.3296	0.0488	-0.0195	-0.0386	0.1831	0.0696	-0.0843	-0.1308	-0.1179	0.0236	-0.1752	0.0104	-0.0733	0.0	-0.1624	-0.2458	0.4082
SPI	0.2267	0.1394	0.5331	-0.4859	0.0792	0.0621	-0.0558	-0.0154	0.0513	-0.2764	0.1327	0.0483	-0.0151	0.1186	-0.0081	0.1035	-0.2035	0.0	0.2535	-0.7356	0.4821
VEG	-0.1727	0.6759	0.4551	0.0823	-0.6719	-0.0142	-0.0867	-0.0621	0.0660	0.1618	0.1675	-0.1976	-0.2257	0.0514	0.0873	-0.2073	0.0047	0.0	0.0934	-0.5570	0.4836
SUG	0.0040	0.0928	0.0800	0.0799	-0.0134	-1.1102	-0.0523	-0.0069	-0.0053	0.0060	-0.0943	-0.1313	-0.0293	0.0278	0.1570	0.0738	-0.0085	0.0	-0.9306	0.6692	0.2814
FRU	-0.0799	0.5263	-0.0360	-0.0694	-0.1031	-0.0571	-1.2326	-0.0294	-0.1578	0.0569	0.0211	0.1657	-0.0201	0.0284	0.1506	0.0118	0.0007	0.0	-0.8279	0.2536	0.5743
TOB	0.2363	-0.4426	-0.0852	-0.0244	-0.0949	-0.0121	-0.0364	-0.9079	0.7595	0.5087	0.1097	-0.0369	-0.2784	0.0232	-1.2233	-0.0007	0.3621	0.0	-1.0594	0.5721	0.4873
MIL	-0.5194	0.0257	0.4260	0.0077	0.1093	-0.0124	-0.2244	0.0418	-0.3983	-0.0002	-0.0942	0.1700	0.1723	-0.0522	0.1978	-0.2144	0.0357	0.0	0.7488	-1.3487	0.5979
MEA	0.4802	-0.4747	0.1782	-0.5382	0.3024	0.0037	0.0903	0.6270	0.0005	-0.4882	-0.0123	-0.0406	-0.1897	0.0673	1.6635	0.0172	0.1863	0.0	2.0550	-3.1818	0.5268
FOO	-0.1838	-0.2523	-0.1759	0.2664	0.5265	-0.1589	0.0553	0.2418	-0.1074	-0.0128	-0.5839	0.2606	-0.2200	-0.3453	0.9600	-0.4215	0.0345	0.0	-0.1390	-0.3733	0.5123
OIL	-0.1921	-0.3171	-0.5843	0.1490	-0.6341	-0.3611	0.4422	-0.0797	0.5197	-0.0705	0.4261	0.0695	-0.0689	0.0056	0.8042	-1.1042	0.0558	0.0	-1.1999	0.4988	0.7011
ALC	-0.3821	-1.2061	-0.5521	-0.0518	-0.7821	-0.0681	-0.0549	-0.8173	0.3484	-0.3403	-0.3820	-0.0713	-1.2444	0.0503	0.4479	-13.7663	0.0133	0.0	-18.6592	18.2389	0.4203
BAL	0.9198	2.8960	0.1217	0.4702	0.1188	0.0860	0.0917	0.0627	-0.1183	0.1573	-0.6852	0.0074	0.0564	-0.0292	0.1280	-1.7299	0.1069	0.0	1.6422	-2.2111	0.5689
EGG	2.8781	-25.8733	-1.3323	-0.0518	0.4498	0.7181	0.8863	-4.3840	0.8558	4.8268	2.6915	1.3745	0.7204	0.1803	-0.1775	-0.1634	-0.0830	0.0	-17.0854	16.2589	0.0266
GRA	-0.0184	-3.7946	0.0860	0.6087	-1.1646	0.5527	0.0612	0.0006	-0.7107	2.4546	-1.2196	-2.0541	-22.9427	-2.5356	-0.1649	-0.1237	-0.0287	0.0	-51.1975	30.9992	0.1983
CHE	-1.5303	3.8504	-1.2230	-2.5383	0.0617	-0.0856	0.0120	2.0746	0.2593	1.0733	0.2173	0.2140	0.0487	0.3377	-0.1818	-0.0614	-1.0975	0.0	4.2320	-4.4047	0.1727
UFO	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FOOD	-0.0203	-0.1268	-0.0028	0.0141	0.0078	-0.0262	-0.0186	-0.0208	0.0193	0.0519	0.0003	-0.0103	-0.1896	0.0164	-0.1063	-0.1913	0.0121	0.0	-0.5913	0.5975	0.1940
NF	-0.0242	0.0633	-0.0432	-0.0478	-0.0405	-0.0029	-0.0100	-0.0018	-0.0381	-0.0673	-0.0173	-0.0005	0.1717	-0.0243	0.0957	0.1773	-0.0143	0.0	-0.3913	-1.3803	1.7718
W	0.0223	0.0296	0.0236	0.0173	0.0169	0.0143	0.0142	0.0111	0.0100	0.0090	0.0087	0.0053	0.0050	0.0044	0.0031	0.0030	0.0014	0.2900	0.4891	0.5109	1.0000

ELASTICITY MATRIX FOR URBAN INCOME 4

(Sri Lanka)

	RCE	BAK	FIS	SPI	VEG	FRU	SUG	TOB	MIL	MEA	FOO	OIL	ALC	BAL	EGG	GRA	CHE	UFO	FOOD	NF	Y
RCE	-0.4404	0.0232	0.1576	0.3071	-0.4098	-0.0623	-0.0311	-0.0952	-0.3642	-0.4434	-0.0323	-0.2743	-0.0711	0.0563	1.3975	-0.2481	-0.0173	0.0	-0.2836	-0.2198	0.5034
BAK	0.0039	-0.2156	0.2064	0.1243	0.0084	0.4524	0.1114	0.0194	-0.0941	-0.3814	0.1756	0.0046	0.0385	-0.0373	-0.1442	-0.3444	0.0152	0.0	-0.2931	-0.1391	0.4342
FIS	0.1032	1.0005	-0.9483	0.4833	-0.4017	-0.2084	-0.2028	0.0797	0.7439	0.1821	0.2103	-0.1977	-0.0787	0.0171	-0.4358	0.0218	0.0410	0.0	1.0337	-1.3444	0.2907
SPI	0.7823	0.7759	0.6292	-0.8072	0.3761	-0.0422	0.0039	0.0001	-0.2055	-0.0696	0.0314	0.0304	-0.0171	0.1033	-0.0128	0.2138	0.0745	0.0	1.2710	-1.7119	0.4409
VEG	-0.5311	0.0583	-0.3526	0.3823	-0.7742	-0.1017	-0.0484	0.0627	-0.2785	0.0321	0.0623	-0.0672	0.0388	0.0158	0.0020	0.4791	0.1237	0.0	-0.2974	-0.0959	0.3935
FRU	-0.0955	3.1772	-0.3211	-0.0487	-0.1177	-1.1739	-0.0473	0.0190	1.2070	0.1231	0.0876	0.0739	-0.0073	0.0708	-0.2098	-0.0313	0.0961	0.0	2.0021	-3.1702	0.3681
SUG	-0.0706	0.6396	-0.3172	0.0060	-0.0566	-0.0479	-1.1111	0.1030	-0.2056	0.0403	0.3033	-0.1603	0.0232	0.0756	0.2001	0.4066	0.0189	0.0	0.0399	-0.5887	0.3488
TOB	-0.1853	0.2089	0.1807	0.0039	0.0974	0.0270	0.1334	-0.7192	0.9048	-0.3158	0.2823	0.1439	-0.3941	0.0366	-0.1132	-0.9373	0.0301	0.0	-0.6116	0.4406	0.1712
MIL	-0.7739	-0.9372	1.3444	-0.3238	-0.4396	1.6358	-0.2756	0.9437	-0.2612	0.0897	0.0113	0.0401	0.0566	-0.0223	-0.2860	-0.4560	0.0356	0.0	1.2196	-1.0922	0.4726
MEA	-0.9399	-3.7827	0.3779	-0.1099	0.0512	0.1672	0.0540	-0.3296	0.6908	-0.3413	0.1323	0.1272	0.0560	0.1939	-0.4035	-0.4827	0.0611	0.0	-4.4562	4.1107	0.3455
FOO	-0.0692	1.0922	0.4705	0.0564	0.1072	0.1289	0.4383	0.3186	0.0140	0.1645	-0.3880	0.2710	-0.4406	-0.2127	-0.3018	-3.3331	0.0112	0.0	-0.0773	0.0198	0.2377
OIL	-1.0377	0.0764	-0.7498	0.0888	-0.1957	0.1798	-0.3893	0.2733	0.0722	0.2290	0.4351	-0.4771	0.2036	0.1056	-0.0688	4.6449	0.0132	0.0	314054	-3.9346	0.3292
ALC	-0.2833	0.7188	-0.3151	-0.0322	0.1144	-0.0200	0.0578	-0.7824	0.1070	0.1047	-0.7776	0.2127	-0.0405	0.0305	0.1781	-4.0232	0.0780	0.0	-6.0962	5.0168	0.4794
BAL	0.2604	-1.2478	0.0733	0.3588	0.0499	0.2073	0.2188	0.1258	-0.0492	0.4247	-0.4527	0.1268	0.0350	-0.0079	-0.1528	-0.1520	0.1063	0.0	-0.9157	0.4133	0.5024
EGG	7.1798	-3.4774	-2.2972	-2.3673	3.0492	-0.6904	0.0419	-0.2951	-0.6459	-0.9773	-0.0014	-0.0921	0.2270	-0.1702	-0.0715	0.2047	-0.1663	0.0	-1.1477	0.3485	0.3994
GRA	-1.0091	-19.3881	4.6933	1.2338	2.7392	-0.1504	1.9684	-3.3330	-1.0493	-1.7474	-11.2343	9.2920	-9.2484	-0.2316	0.4289	-0.2481	-0.0323	0.0	-29.2328	29.1598	0.0730
CHE	-0.5108	1.5537	0.7473	1.0416	1.7000	1.1583	0.2008	0.2734	0.4078	0.3543	0.0928	0.0733	0.3610	0.4272	-0.3963	-0.0778	-1.0402	0.0	0.4097	-6.4142	0.0043
UFO	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FOOD	-0.0048	-0.0381	0.0433	0.0438	-0.0069	0.0779	0.0026	-0.0152	0.0287	-0.0881	-0.0160	0.0391	-0.0633	-0.0073	-0.0081	-0.1818	0.0145	0.0	-0.1398	-0.0559	0.2157
NF	-0.0275	-0.1257	-0.0668	-0.0582	-0.0189	-0.0807	-0.0223	-0.0039	-0.0559	0.0325	-0.0020	-0.0383	0.0403	-0.0015	-0.0001	0.1201	-0.0129	0.0	-0.0458	-0.9371	1.6027
W	0.0183	0.0883	0.0181	0.0139	0.0157	0.0118	0.0116	0.0091	0.0087	0.0087	0.0081	0.0048	0.0046	0.0040	0.0036	0.0024	0.0010	0.2038	0.4545	0.3833	1.0000

ELASTICITY MATRIX FOR URBAN INCOME 5&6

(Sri Lanka)

	RCE	BAK	FIS	VEG	OF2	FRU	MEA	MIL	SUG	TOB	FOO	ALC	OIL	EGG	MAL	GRA	CHE	UFO	FOOD	NF	Y
RCE	-0.4125	-0.0380	0.0164	-0.0549	0.4489	0.1655	0.1381	0.0384	0.0920	0.0777	0.0625	-0.1192	-0.3042	0.0428	0.0893	-0.1939	-0.0596	0.0	-0.1953	0.0332	0.1601
BAK	-0.0060	-0.1400	-0.1221	0.0955	-0.0986	-0.0329	0.0316	0.1904	-0.0315	-0.1889	-0.0942	-0.0171	-0.2152	0.4742	0.0018	0.5228	0.1882	0.0	0.5300	-0.6635	0.3535
FIS	0.0155	-0.8776	-0.8992	0.1151	0.2774	-0.0834	-0.0420	0.2408	-0.0074	0.1295	-0.0480	0.1418	-0.4448	0.2388	-0.0292	0.0101	0.0484	0.0	-1.4006	1.1524	0.2480
VEG	-0.0634	0.8825	0.1472	-0.6275	0.3691	-0.1118	0.0624	0.3440	-0.0035	-0.0725	0.0095	0.2065	-0.1067	-0.0770	-0.0319	-0.1851	0.0855	0.0	0.8275	-1.1144	0.2891
OF2	0.5552	-0.9665	0.5789	0.5870	-0.4160	-0.0760	0.0897	0.1255	-0.0028	-0.0632	-0.0709	0.5155	-0.3429	-0.0112	0.0741	0.3057	0.1109	0.0	0.5752	-0.4157	0.2425
FRU	0.1948	-0.5270	-0.1159	-0.1190	-0.0775	-0.9254	0.2364	0.8017	-0.0578	0.0607	-0.0098	0.1242	-0.1834	0.1100	-0.0410	-0.1090	0.0070	0.0	-0.4250	0.1329	0.2921
MEA	0.1740	0.5307	-0.0621	0.0695	0.0930	0.2480	-0.2859	0.0557	0.0644	-0.0271	0.1302	-0.0715	-0.2192	-0.0245	0.0650	0.3839	0.0660	0.0	1.0920	-1.4567	0.3647
MIL	0.0491	2.0730	0.3927	0.5979	0.1380	0.8716	0.0377	-0.4520	-0.0027	-0.1748	0.0395	0.0936	0.0785	-0.0917	-0.0140	-0.0308	0.0935	0.0	5.3187	-5.4748	0.5358
SUG	0.1201	-0.5585	-0.0113	-0.0040	-0.0034	-0.0411	0.0675	-0.0025	-1.0014	0.0247	0.0674	-0.2348	0.2301	0.0694	0.0488	-0.2125	-0.0815	0.0	-1.3949	1.3064	0.2885
TOB	0.1555	-2.4901	0.2595	-0.1106	-0.0925	0.0882	-0.0361	-0.2308	0.0360	-0.9434	-0.0856	0.7198	0.4075	0.0206	-0.0345	0.0477	0.1189	0.0	-2.2526	2.0448	0.1878
FOO	0.1196	-1.4894	-0.1032	0.0167	-0.1142	-0.0149	0.1979	0.0584	0.0991	-0.0948	-0.3472	-0.1394	0.2090	0.4205	-0.1256	0.2515	0.5388	0.0	-0.7191	0.5300	0.1891
ALC	-0.2849	-0.5342	0.5551	0.5982	0.5818	0.2277	-0.1260	0.1550	-0.5959	0.9082	-0.1418	-1.1226	0.1775	-0.2332	-0.1074	-2.7035	-0.4935	0.0	-3.3434	2.6381	0.0833
OIL	-0.7886	-4.6132	-1.9195	-0.2436	-0.7894	-0.5928	-0.4442	0.1540	0.4434	0.0995	0.2802	0.2090	0.2502	-0.0055	0.0459	-0.0451	0.0718	0.0	-6.0474	6.4561	0.4115
EGG	0.1127	10.5095	0.7521	-0.1824	-0.0245	0.2428	-0.0520	-0.1871	0.1405	0.0306	0.5845	-0.2825	-0.0034	-0.5214	-0.0392	-0.1081	-0.2297	0.0	10.9007	-11.3232	0.4225
MAL	0.2630	0.0535	-0.1026	-0.0037	0.1050	-0.1527	0.1525	-0.0528	0.1100	-0.0984	-0.1972	-0.1455	0.0529	-0.0666	-0.0428	-0.5751	-0.0951	0.0	-1.5928	1.0788	0.3140
GRA	-1.8175	25.0787	0.1099	-1.5259	2.4082	-0.0457	2.8527	-0.2181	-1.5131	0.2567	1.2254	-11.4964	-0.1426	-0.3775	-2.7899	-0.7595	-0.0670	0.0	11.3322	-11.4498	0.1174
CHE	-2.2532	58.4455	2.0819	2.8222	5.4957	0.2177	1.9481	2.4600	-2.3222	2.5564	6.6066	-11.7878	1.0418	-5.2151	-1.1879	-0.2881	-1.0719	0.0	59.7852	-59.9704	0.1832
UFO	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FOOD	-0.0021	0.0332	-0.0205	0.0115	0.0035	-0.0055	0.0234	0.0361	-0.0134	-0.0170	-0.0047	-0.0186	-0.0555	0.0564	-0.0062	0.0144	0.0218	0.0	0.0912	-0.1492	0.0780
NF	-0.0141	-0.2025	0.0036	-0.0284	-0.0204	-0.0095	-0.0294	-0.0345	0.0061	0.0112	-0.0030	0.0131	0.0365	-0.0750	0.0020	-0.0219	-0.0270	0.0	-1.5275	-0.7942	2.1213
W	0.0075	0.0621	0.0084	0.0064	0.0063	0.0062	0.0039	0.0037	0.0037	0.0045	0.0039	0.0034	0.0029	0.0028	0.0025	0.0008	0.0002	0.4134	0.5488	0.4312	1.0000

ELASTICITY MATRIX FOR RURAL INCOME 1

(Sri Lanka)

	RCE	072	9RO	71E	8UO	PR9	66K	096	TOO	CR8	ALC	POO	MAL	OIL	MIL	MOA	8GO	UTO	FOOD	9F	9
RCE	-1.3060	0.1626	0.5070	-0.4963	-0.0271	0.3916	-0.3667	6.7060	0.0076	-0.0269	-0.0915	-0.1029	0.0203	0.0057	-0.6610	-0.6206	-0.4069	0.0	1.2062	-5.1729	0.7067
072	0.2030	-0.6360	0.2066	-0.0709	0.0736	0.0676	-0.2320	-0.3233	0.0632	-0.0103	-0.0146	-0.0106	0.0301	0.0057	-0.0663	0.7003	0.0020	0.0	0.6367	-1.1639	0.2112
990	0.6165	0.2166	-0.6396	0.0669	-0.0013	-0.0516	-0.6600	-0.3063	0.0353	0.0366	-0.0636	-0.0611	-0.0322	-0.0735	-0.0361	-0.0657	-2.7060	0.0	-6.2292	5.6916	0.5201
710	-1.0000	-0.0629	0.0776	-1.1670	0.0976	-0.1035	0.0765	0.0626	0.0466	0.0470	0.3431	-0.0310	0.0606	-0.0060	1.2920	0.1610	1.6036	0.0	0.5199	-1.0269	0.5070
890	-0.0072	0.0903	-0.0000	0.0990	-2.3612	-0.0360	-0.2027	0.4317	0.0260	0.0040	-0.3605	0.6773	-0.0201	-0.1205	-0.6316	0.0466	0.7026	0.0	-1.2232	0.4097	0.7635
PR9	1.0406	0.0772	-0.0320	-0.2022	-0.0627	-1.1130	-0.1306	-1.6796	0.0200	-0.0063	0.1672	-0.1276	0.0231	-0.0150	-0.0023	0.3440	0.3224	0.0	-1.0096	0.0242	0.1722
06R	-1.6757	-0.6170	-1.5169	0.1205	-0.3233	-0.1717	-0.3036	0.6315	-0.0232	0.7021	0.0626	0.0437	-0.0571	-0.0306	-0.3766	0.2203	0.7730	0.0	-5.0670	5.0122	0.2226
ORA	20.0339	-1.2156	-1.3072	0.1326	0.7909	-2.3196	0.9033	-0.5395	0.2390	-0.0142	-0.2905	-0.0776	0.0335	0.6066	-0.1263	0.0211	1.0160	0.0	10.3767	-10.3267	0.1000
TO8	0.6082	0.1066	0.0036	0.0947	0.0316	0.0427	-0.0373	0.2297	-0.9490	0.1031	0.3731	-0.7760	-0.0330	0.2207	1.0206	-1.2223	-5.1200	0.0	-3.3096	6.0622	0.4675
C98	-0.1306	-0.0616	0.1926	0.1400	0.2215	-0.0735	0.0096	-0.0230	0.2630	-0.0322	-0.1407	-0.3406	-0.0613	-0.1200	0.1206	0.6679	0.2440	0.0	0.3022	-1.0313	0.4493
ALC	-0.6275	-0.0776	-0.1204	1.2737	-0.9200	0.3479	0.1076	-0.6306	0.5375	-0.1707	-9.0609	-0.0375	-0.0426	0.3100	-0.1272	-0.3363	-1.0265	0.0	-5.3977	1.3093	1.2882
F09	-0.0216	-0.0360	-0.2613	-2.9935	1.5669	-0.4462	0.1022	-0.1216	-1.5999	-0.4242	-0.0629	-0.3451	0.0295	-0.0267	0.5661	0.2307	0.3292	0.0	-5.1422	6.3012	0.0410
96L	0.2203	0.1267	-0.1260	0.5461	-0.0902	0.0670	-0.1345	0.9230	-0.0425	-0.0326	-0.0461	0.0316	-0.9063	-0.1464	-0.1276	-0.2939	0.1046	0.0	-1.0694	0.6439	0.6233
O2L	0.0420	0.0136	-0.3675	-0.3342	-0.4625	-0.0700	-0.1216	0.9735	0.6400	-0.1790	0.7063	-0.6170	-0.1626	-0.6772	-0.2200	-0.1732	-0.6360	0.0	-1.9450	1.0461	0.0997
MIL	-6.0602	-0.3776	-0.3065	6.0306	-3.9946	-0.0226	-1.5400	-0.3334	5.6232	0.1910	-9.1972	0.3462	-0.1636	-0.2669	-0.1317	0.0320	-0.0671	0.0	-6.9022	6.2116	0.6926
MOA	-7.6796	6.7360	-0.6223	1.2070	0.4040	5.7936	1.2066	0.0730	-6.6203	1.7963	-0.9160	0.0060	-0.6339	-0.3300	0.0070	-0.3209	-3.6946	0.0	-2.0320	1.0291	0.9779
890	-20.4933	27.0316	-82.7263	36.2065	17.0646	7.3753	26.3605	15.6475	-67.7406	3.1321	-16.4216	2.6261	1.2413	-6.3525	-0.3776	-12.0896	-0.6016	0.0	-87.2726	86.6790	0.2966
UTO	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FOO9	0.2029	0.0306	-0.2670	0.0263	-0.0336	-0.0360	-0.2201	0.5428	-0.1329	0.0122	-0.0423	-0.0797	-0.0131	-0.0346	-0.0390	-0.0103	-0.1922	0.0	-0.2739	-0.0930	0.2709
0F	-0.3320	-0.1165	0.5200	-0.0921	0.0026	0.0036	0.0063	-0.3690	0.1222	-0.0223	0.0223	0.0621	-0.0009	0.0099	0.0463	0.0110	0.1090	0.0	-0.7197	-0.9026	1.4232
W	0.0646	0.0267	0.0233	0.0291	0.0266	0.0232	0.6203	0.0160	0.0142	0.0100	0.0099	0.0081	0.0080	0.0075	0.0062	0.0036	0.0011	0.1011	0.4962	0.3913	1.0000

ELASTICITY MATRIX FOR RURAL INCOME 2

(Sri Lanka)

	RCE	FIS	DPL	VEG	SUG	FRU	BAV	TOB	FUE	ALC	MIL	OVG	COB	NAL	OIL	MOS	OOO	OFO	FOOD	EF	Y
RCE	-0.7610	0.0229	-0.2151	-0.2229	0.0400	0.0676	0.1005	0.0293	-0.0226	-0.0069	0.0902	-0.2002	-0.1620	0.0225	0.0413	0.4002	-0.0416	0.0	-1.0201	1.2167	0.6224
FIS	0.0291	-0.9204	0.0922	0.2267	-0.0422	0.1492	-0.0062	0.0212	-0.0292	0.0477	-0.0773	-0.4061	0.0610	0.0224	-0.2224	0.6121	0.1620	0.0	-0.2221	-0.1222	0.6476
DPL	-0.4402	0.1074	-0.6670	0.1672	0.0277	0.0999	0.0721	0.0042	-0.1072	0.0019	-0.0912	-0.1492	-0.0021	0.0409	0.0722	0.1767	-0.2913	0.0	-1.1090	0.0029	0.2022
OSG	-0.6740	0.3754	0.1719	-0.0720	0.0174	-0.0715	0.2621	0.0020	-0.1042	-0.0162	-0.2410	-0.2973	0.0625	0.0022	0.0691	0.1261	0.2722	0.0	-1.1720	0.7440	0.6290
SUG	0.0902	-0.0497	0.0244	0.0204	-1.0226	0.0422	0.1207	0.0076	-0.0202	0.0122	-0.2090	-0.9092	0.0102	-0.0029	-0.0099	0.0227	0.3627	0.0	-1.4229	1.0272	0.4146
FRN	0.1905	0.2246	0.1106	-0.0920	0.0202	-0.9626	0.1209	0.0250	-0.1067	-0.1116	-0.0602	-0.6107	0.0407	0.0120	0.0221	0.1102	0.2093	0.0	-0.9226	0.4707	0.4449
BAO	0.2107	-0.1216	0.1129	0.2200	0.1676	0.1499	-0.4022	0.1077	-0.0211	0.1402	0.2014	0.9743	-0.0226	0.0565	-0.1290	0.2276	-0.2407	0.0	2.2100	-2.4226	0.2224
TOB	0.1214	0.0961	-0.0024	-0.0074	0.0009	0.0256	0.1220	-1.0090	-0.0206	0.4610	0.1212	-0.4920	0.1492	-0.0720	0.1260	0.2112	0.3076	0.0	0.2761	-1.5992	1.0226
FOU	-0.2976	-0.0709	-0.4600	-0.4457	-0.0474	-0.2009	-0.0420	-0.0269	-0.2201	0.0921	0.2106	-0.0420	0.4222	0.2222	0.6100	-0.0516	1.9226	0.0	0.2202	-1.0110	0.7222
ALC	-0.0272	0.1240	0.0047	-0.0400	0.0202	-0.2097	0.2422	0.6107	0.0922	-0.9126	-0.0209	0.2476	0.2623	-0.1429	-0.6703	0.1621	-0.1123	0.0	-0.0021	-0.4143	0.2096
MIL	0.2492	-0.2260	-0.2726	-0.7173	-0.2270	-0.1269	0.7742	0.2029	0.3702	-0.0724	-0.6020	-0.2205	0.0070	-0.0107	0.1110	-0.2200	0.0002	0.0	-1.2099	0.0614	0.5292
GVA	-2.1632	-1.0204	-0.6422	-1.9790	-2.6615	-2.6092	2.2017	-0.0271	-1.1912	0.7720	-0.2747	-0.6910	-0.0174	0.0770	0.7117	0.2422	0.2497	0.0	-9.2294	9.2422	-0.0020
CVB	-1.2620	0.2073	-0.0070	0.2220	0.0249	0.1266	-0.0971	0.3292	0.7690	0.4442	0.0111	-0.0226	-0.9269	-0.0226	-0.0097	-0.0224	-1.2295	0.0	-1.6748	1.2120	0.4470
VAL	0.1020	0.1575	0.1706	0.0173	-0.0129	0.0272	0.2726	-0.1622	0.2966	-0.2222	-0.0270	0.0920	-0.0290	-0.9422	0.2026	0.0225	-0.2670	0.0	-0.2262	-0.4741	0.7106
OIL	0.2644	-1.2974	0.2260	0.2021	-0.0420	0.1090	-0.4992	0.2092	0.7600	-1.2424	0.1426	0.9227	-0.1000	0.2150	-0.6622	0.1200	0.3500	0.0	0.1402	-0.9622	0.8152
MEA	4.2427	2.4124	0.9121	0.4929	0.2429	0.4247	0.0011	1.4222	-0.1007	0.2462	-0.2944	0.2904	-0.0679	0.0407	0.1407	-0.1646	-0.1406	0.0	11.0492	-11.2292	0.4891
EGG	-15.2246	3.1275	-2.4706	2.1766	2.6640	0.9740	-2.0092	3.2020	9.4146	-0.2422	0.0010	1.0029	-2.9379	-1.0101	0.6770	-0.2247	-0.4119	0.0	-2.9022	2.2224	0.2221
UTO	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FOOD	-0.1100	-0.0112	-0.0229	-0.0292	-0.0422	-0.0220	0.0276	0.0215	0.0092	0.0012	-0.0122	-0.1047	-0.0142	0.0004	0.0041	0.0022	-0.0006	0.0	-0.2260	0.0276	0.1992
EF	0.0212	-0.0296	-0.0020	0.0021	0.0127	-0.0070	-0.1061	-0.0227	-0.0210	-0.0212	0.0022	0.1190	0.0062	-0.0119	-0.0129	-0.1129	0.0960	0.0	-0.9699	-1.0477	2.0172
W	0.0425	0.0220	0.0214	0.0210	0.0102	0.0162	0.0142	0.0116	0.0080	0.0007	0.0071	0.9062	0.0022	0.0020	0.0047	0.0961	0.0018	0.2270	0.2294	0.4404	1.9900

ELASTICITY MATRIX FOR RURAL INCOME 3

(Sri Lanka)

	RCC	BAK	FIS	VEG	SPI	EGG	PRO	TOO	FOO	ALC	MIL	MEA	DAL	OGA	OIL	COC	SCO	OFO	FOOD	OF	Y
RCO	-0.0736	0.0137	-0.7404	0.3039	-0.1710	0.0300	0.0199	0.0145	0.0424	0.0477	0.4630	-0.3301	-0.1042	0.2405	0.1905	0.0707	0.0541	0.0	-0.6406	0.5549	0.5257
BAK	0.0093	-0.1751	0.7037	0.4570	0.0031	-0.2377	-0.3099	-0.0560	0.1600	-0.2044	0.0056	-0.1432	0.2794	-0.9077	0.2400	0.5265	2.4953	0.0	2.0170	-2.5390	0.5215
FIS	-1.5003	1.3746	-0.4130	0.2702	0.0134	-0.1300	0.2745	0.0741	-0.0121	-0.1002	-0.0011	0.5104	-0.0305	0.4054	0.0430	0.0100	0.4555	0.0	1.1721	-1.7556	0.5015
VEG	0.5905	0.0709	0.5240	-0.6455	0.1411	-0.0499	-0.0973	-0.0002	-0.0095	-0.1059	-0.0390	0.5075	0.0061	0.0759	-0.0019	0.0250	-0.4504	0.0	0.0034	-1.2190	0.5550
SPI	-0.5449	0.1749	0.0300	0.1442	-0.7559	-0.0531	0.0540	-0.0470	0.0463	0.0574	-0.1125	0.1395	0.0110	0.5542	0.0010	0.0414	-0.2555	0.0	-0.4006	0.0559	0.5467
EGG	0.0475	-0.5904	-0.1021	-0.0374	-0.0361	-1.0354	0.0414	-0.0261	-0.0627	0.0000	0.1771	0.1740	0.0222	-0.2520	0.0040	-0.0276	-0.1410	0.0	-1.7197	1.4725	0.5375
PAO	0.0475	-0.0103	0.4106	-0.1311	0.0711	0.0460	-0.6417	0.0270	0.0155	0.2741	0.6755	-0.0141	0.0540	-0.4255	0.0900	0.0362	0.1142	0.0	-0.1490	-0.2007	0.4537
TUB	0.0519	-0.1052	0.1370	-0.1349	-0.0001	-0.0475	0.0301	-0.7791	-0.0149	-0.0755	-1.5151	-0.3009	0.1276	-0.0495	-0.0993	0.0104	-0.0340	0.0	-6.3003	5.1910	1.0167
POO	0.1437	0.6030	-0.0259	-0.1441	0.1730	-0.0993	0.0199	-0.0112	-0.2040	-5.5024	0.5555	-0.3040	1.7970	0.4431	0.0249	0.9443	1.0251	0.0	1.5510	-2.0725	0.5709
ALC	0.2536	-0.0559	-0.2415	-0.2250	0.1049	0.1437	0.4102	-1.0755	-4.0000	-1.0739	0.1055	-0.0540	0.1162	-0.1375	0.1955	0.1559	-0.0540	0.0	-0.1455	5.2740	0.0495
MIL	2.3031	0.0100	-0.2310	-0.0000	-0.2730	0.5403	1.2440	-2.2242	0.4524	0.1245	-0.0741	-0.2479	-0.0202	-0.2200	0.4010	0.0079	0.5936	0.0	1.0902	-2.6476	0.7574
MEA	-1.4406	-0.0494	1.0903	1.1401	0.4037	0.4401	-0.0532	-0.5701	-0.6705	-0.0740	-0.1012	-0.3125	0.0991	2.4971	0.0064	0.0972	-0.1130	0.0	1.9252	-2.4701	0.4049
DAL	-1.5007	2.5303	-0.1397	0.0355	0.0405	0.0771	0.1090	0.5341	4.1301	0.2397	-0.0449	0.1301	-0.9549	0.4924	0.0035	-0.0413	-0.2124	0.0	5.1041	-5.4510	0.3749
OGA	2.0203	-7.4951	1.0074	0.5235	1.4003	-0.0343	-1.5521	-0.1065	1.0351	-0.2575	-0.3040	5.5517	0.5071	-0.5675	-0.0963	0.0910	0.6672	0.0	0.5442	-0.4565	-0.1099
OIL	1.7171	2.2255	0.2275	-0.0115	0.5549	0.3159	0.3069	-0.2427	0.0425	0.4274	0.0049	0.1294	0.0004	-0.1059	-0.3030	0.0785	-0.1440	0.0	5.9774	-6.4005	0.5101
COC	0.0059	5.5194	0.0705	0.1505	0.3177	-0.1701	0.1075	0.0056	2.0541	0.6091	0.0190	0.1755	-0.0550	0.1134	0.0967	-1.2345	-1.0594	0.0	5.3040	-5.0927	0.7507
SCO	0.6754	32.2309	5.3007	-2.9746	-1.6064	-0.7775	0.5550	-2.4106	5.1355	-0.7070	1.0575	-0.2447	-0.5524	0.9011	-0.2595	-1.9919	-0.0525	0.0	32.4579	-33.0475	0.5036
OFO	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FOOD	-0.0310	0.1725	0.0405	0.0201	-0.0000	-0.0404	-0.0000	-0.0459	0.0270	-0.0002	0.0740	0.0207	0.0550	0.0028	0.0595	0.0390	0.1444	0.0	0.5451	-0.5151	0.1440
OF	-0.0514	-0.2992	-0.1033	-0.0750	-0.0360	0.0211	-0.0301	0.0409	-0.0571	0.0044	-0.0491	-0.0394	-0.0557	-0.0134	-0.0595	-0.0450	-0.1941	0.0	-1.7554	-0.3309	2.0905
W	0.0316	0.0333	0.0106	0.0142	0.0150	0.0137	0.0132	0.0097	0.0090	0.0079	0.0046	0.0054	0.0039	0.0038	0.0056	0.0030	0.0035	0.3495	0.5440	0.4340	1.0000

ELASTICITY MATRIX FOR RURAL INCOME 4

(Sri Lanka)

	RCE	BAK	PLS	VEG	OFS	SUG	SAO	MIL	FOM	BEV	ALC	MEA	DAL	OIL	GDS	DOC	COE	OTH	FOOD	NF	W
RCE	-0.0370	-0.0199	-0.2300	-0.9039	0.4615	-0.1227	0.1322	-0.2205	-0.3124	0.1720	-0.0242	0.2064	-0.1494	-0.4190	-1.4290	0.7261	0.1040	0.0	-1.2079	1.9229	0.1740
BAK	-0.0271	-0.4620	0.1210	-0.0717	0.4721	-0.0670	-0.3630	-0.4120	0.1739	-0.3603	-0.2717	-0.9312	-0.1409	0.4090	0.0049	-0.4104	0.1112	0.0	-1.9791	1.3461	0.9130
PLS	-0.2792	0.3129	-0.0347	0.4922	0.2012	-0.2009	0.4422	-0.3469	-0.0225	0.2177	-0.2515	0.2757	0.0000	-0.0092	-0.1992	-0.2000	-0.0249	0.0	-0.0262	-0.2772	0.3719
VEG	-1.2649	-0.1390	0.4919	-0.2931	0.0920	0.0482	-0.3401	-1.1032	-0.3100	-0.0276	0.1009	0.1249	-0.1960	-0.1132	1.1203	0.4007	0.3175	0.0	-1.4149	1.2941	0.0340
OFS	0.0272	1.2907	0.6914	0.0929	-0.7410	0.0692	0.0030	0.1445	0.0172	-0.0279	-0.2203	0.0115	-0.0610	0.0092	0.4669	-0.0009	0.0400	0.0	2.7034	-3.0490	0.2346
SUG	-0.2000	-0.1007	-0.3692	0.0577	0.0702	-0.9313	-0.0922	0.2190	0.2202	0.0094	-0.6271	-0.0620	0.0912	-0.3019	0.0107	0.0305	0.0012	0.0	-0.9692	0.0337	0.1330
SAO	0.2035	-1.3322	0.6192	-0.4223	0.1031	-0.1044	-1.2640	0.0009	0.0970	0.1023	-0.1172	-0.0109	0.1270	-0.4212	1.3271	0.0201	0.0427	0.0	0.0399	-0.2914	0.3610
MIL	-1.0302	-1.9907	-0.2265	-1.0160	0.2100	0.9000	0.0923	-0.1990	-0.0292	-0.0229	0.0231	-0.4269	-0.0272	0.7963	0.2944	-0.0397	-0.3929	0.0	-9.1915	5.2022	0.9022
FOM	-1.0470	0.0219	-0.1732	-0.4075	0.1004	0.2600	0.1437	-0.0429	-0.7927	-0.0392	0.0497	-0.9245	-0.3247	-0.2969	-2.2925	14.2242	-0.0625	0.0	2.6047	-7.7109	0.2342
BEV	0.5791	-1.7010	0.9425	-0.1269	-0.0294	0.0092	0.1491	-0.0204	-0.0215	-0.9272	-0.7209	-1.1025	0.9256	-1.1057	2.4297	0.9922	0.0212	0.0	-1.2079	0.3032	1.1041
ALC	-0.1421	-2.0777	-0.9349	0.2042	-0.9029	-1.1071	-0.2121	0.0200	0.0479	-0.0404	-0.7372	-0.2637	-0.2705	-9.4730	-2.1010	0.9494	-1.0220	0.0	-9.5167	7.2032	2.0132
MEA	2.2979	-5.0020	1.0110	0.2170	0.0240	-0.1401	-0.0222	-0.9002	-0.6997	-1.5410	-0.2707	-0.6209	-0.2163	-0.2001	0.2963	-1.1029	0.1321	0.0	-5.2092	9.9170	0.5912
DAL	-1.0216	-1.6190	0.0041	-0.9522	-0.2156	0.2004	0.4021	-0.0922	-0.6910	0.0727	-0.6709	-0.2209	-0.7932	0.3007	0.7720	0.0940	-0.0962	0.0	-5.0274	9.7232	0.3039
OIL	-2.0632	5.0225	-0.4029	-0.4072	0.0210	-0.7047	-1.4459	2.0492	-0.9234	-2.2797	-0.2025	-0.6427	0.2211	0.6279	0.2499	-0.2922	-0.0271	0.0	-2.0355	2.0279	0.7774
GDS	-11.3402	0.0643	-0.9129	5.4907	3.9320	3.0299	2.7979	1.1040	-10.4242	5.9979	-4.2021	1.9195	0.9022	0.1720	-0.1732	-0.2012	0.0920	0.0	-2.3472	2.9003	0.1192
DOC	9.0494	-5.9577	-1.1001	2.0913	-0.0074	0.1902	5.3902	-2.0413	30.9040	1.0102	1.2219	-2.4210	0.1256	-0.3309	-0.4277	-1.2191	0.0625	0.0	41.0167	-42.4762	0.6597
CHE	3.2411	1.0030	-0.2400	0.9060	0.3727	0.0079	0.2279	-0.9907	-0.3290	0.1167	-2.1271	0.2570	-0.3672	-0.0912	0.1400	0.0027	-3.0000	0.0	-0.6037	0.2000	0.1939
OTH	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FOOD	-0.0242	-0.0719	0.0014	-0.0290	0.0429	-0.0120	0.0010	-0.0420	0.0697	-0.0053	-0.0660	-0.0341	-0.0133	-0.0101	-0.0123	0.1421	-0.0009	0.0	-0.0070	-0.0101	0.0979
NF	0.0301	0.0427	-0.0327	0.0134	-0.1000	-0.0012	-0.0249	0.0209	-0.1321	-0.0061	0.0142	0.0440	0.0140	0.0097	0.0123	-0.2170	-0.0020	0.0	-1.4077	-0.9036	2.4443
W	0.0191	0.0269	0.0119	0.0110	0.0099	0.0090	0.0002	0.0067	0.0027	0.0029	0.0049	0.0042	0.0038	0.0039	0.0036	0.0021	0.0012	0.4042	0.4179	0.3012	1.0000

ELASTICITY MATRIX FOR RURAL INCOME 5&6

(Sri Lanka)

	RCE	BAK	FIS	VEG	OFT	FRU	SUG	POU	MIL	TOB	HBA	ALC	OIL	BAL	ECG	CRA	CHE	UFO	FOOD	NF	Y
RCE	-0.3717	-0.0894	-0.4775	-0.2504	0.0743	-0.0189	0.0131	-0.7399	-0.2524	0.0435	0.1695	-0.4093	-0.5501	-0.1899	0.0139	0.2400	-0.3731	0.0	-2.3130	2.0110	0.2020
BAK	-0.0455	-0.4218	0.9108	-0.1255	0.0841	0.2004	-0.3484	-0.0207	0.3029	-0.0537	-0.5115	0.0037	1.0793	-0.1176	1.1343	-0.2338	0.2903	0.0	2.9530	-3.3754	0.4724
FIS	-0.9409	2.0375	-0.5995	-0.4013	-0.1293	0.0035	0.0265	-0.0373	0.5209	-0.3903	-0.5300	-0.0357	-2.2017	-0.2074	1.3134	2.3200	0.0929	0.0	3.0424	-4.2089	0.5482
VEG	-0.4306	-0.4573	-0.4977	-1.3593	-2.9190	0.0535	0.4918	0.0914	-0.3410	0.1024	-0.2715	0.1357	-0.3977	-0.1331	-0.9083	0.5945	-0.2323	0.0	-4.6313	4.5385	0.4220
OFT	0.1403	3.5148	-0.1932	-1.7927	-1.1497	-0.0840	0.0441	-0.0173	0.0755	0.5900	-0.2062	-0.3935	0.5130	-0.3149	0.0994	-0.7495	0.3373	0.0	0.4395	-0.6713	0.2423
FRU	-0.0407	0.0320	1.0993	0.0930	-0.0894	-1.3007	-0.3747	-0.1379	-0.0021	0.0596	-0.5290	0.0124	-0.5050	0.0305	-1.3899	0.4165	0.4724	0.0	-1.0283	1.3713	0.4370
SUG	0.0281	-1.1787	0.0794	0.6701	0.0730	-0.7694	-2.0103	0.1082	0.1474	-0.0028	-0.3574	0.0947	0.0874	0.0444	1.3144	-1.1519	0.7172	0.0	-0.0088	0.9000	0.2098
POU	-0.3030	-0.1149	-0.1008	0.0808	-0.0255	-0.1888	0.1285	0.3047	-0.1433	0.4302	0.3349	-1.0793	-1.5329	1.3933	3.0048	0.6740	0.0	0.0	3.0039	-2.5189	0.5148
MIL	-0.7703	1.7767	6.0239	-0.3673	0.1754	-1.1949	0.1670	-0.1568	-0.4970	0.0597	-0.1952	0.0409	0.5450	-0.0420	3.0070	0.0933	-2.9995	0.0	1.6301	-1.6111	0.1810
TOB	0.1603	-0.3050	-0.0731	0.2198	0.7481	0.1043	-0.0039	0.9047	0.0738	-1.7051	-1.0397	0.4723	-7.4916	0.3313	0.1810	-0.3375	-0.4342	0.0	-3.9532	3.9413	0.0118
HBA	0.7970	-4.0353	-7.9086	-0.3799	-0.4797	-1.3019	-0.7539	0.3849	-0.2903	-1.3250	-0.4449	0.5593	1.0218	0.3388	-0.0355	-0.4339	0.0	0.0	-9.7180	6.3720	0.3452
ALC	-2.0981	0.0397	-0.1229	0.4539	-0.9014	0.0313	0.1500	-3.1153	0.0703	0.9593	0.5906	-0.4335	-0.3488	0.3809	5.4395	0.1478	0.4351	0.0	3.1185	-2.6408	0.5113
OIL	-3.1985	13.9331	-5.1003	-1.5025	1.6476	-1.3413	0.2443	-3.5763	0.7355	-2.4379	1.3923	-0.4388	0.1694	-0.2814	0.1403	0.3230	-0.0749	0.0	1.0948	-1.5083	0.4235
BAL	-1.1327	-1.4087	-0.0398	-0.5520	-0.9889	0.0934	0.7291	3.0150	-0.0889	0.3042	0.4383	0.4538	-0.2873	-0.4879	0.3033	0.3761	-0.1417	0.0	-0.4168	0.0376	0.3892
ECG	0.1032	10.9895	6.9996	-3.1417	0.4730	-3.1474	6.3195	9.7592	10.6899	0.3952	-7.4429	0.5256	0.1858	0.5031	-0.3103	-1.0889	1.7098	0.0	48.9818	-49.5579	0.9087
CRA	2.0589	-9.1414	19.4708	3.9442	-4.3974	3.5092	-9.1789	4.5420	0.3977	-1.0758	-1.1102	0.3390	0.4254	0.7138	-1.5956	-3.0249	0.2089	0.0	13.5391	-14.1379	0.5735
CHE	-4.9359	10.1990	0.7919	-2.9261	3.3291	4.3211	1.7805	0.0018	-19.9492	-3.1215	0.0009	1.5192	-0.1053	-0.4234	2.5374	0.5187	-1.4491	0.0	-4.9323	4.7883	0.1441
UFO	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FOOD	-0.0418	0.1378	0.0535	-0.0335	0.0057	-0.0759	-0.0095	0.0175	0.0103	-0.0100	-0.0415	0.0094	0.0043	-0.0007	0.1227	0.0738	-0.0033	0.0	0.1944	-0.2400	0.0538
NF	0.0388	-0.3134	-0.7703	0.0790	-0.0297	0.0103	-0.0048	-0.0453	-0.0310	0.0765	0.0469	-0.0240	-0.0157	-0.0047	-0.3257	-0.0439	0.0079	0.0	-2.1331	-0.3379	2.7040
Y	0.0177	0.0796	0.0085	0.0075	0.0087	0.0044	0.0059	0.0049	0.0044	0.0075	0.0029	0.0015	0.0071	0.0021	0.0016	0.0011	0.0007	0.5474	0.9437	0.3568	1.0090